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SURGERY OF THE LABYRINTH.*

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The following paper is based upon 11 cases of labyrinthine suppuration and necrosis.† Of these, four occurred in the course of acute or subacute mastoiditis; seven, in the chronic suppuration. In *four,* neither symptoms were present, nor was there anything in the previous histories suggesting inner ear involvement; the labyrinthine invasion was discovered at the time of the mastoid operation.

In *three,* no symptoms were present at the time of operation, though the previous history in each pointed to labyrinthine disturbance.

In *four,* decided symptoms were present at the time of operation.

In *three* of the eleven cases infective sinus thrombosis complicated the labyrinthine disease. In two of these the jugulars were thrombosed.

This relative frequency of sinus involvement is of surgical interest when we consider the vascular connection between the veins of the vestibule, the semicircular canals and the lateral sinus, and those of the cochlear and the inferior petrosal.

Three of the eleven cases died. The first death was from meningitis resulting from operative interference. The second death occurred in one of the sinus thrombosis cases and was due to meningitis resulting from operative interference. Though the sinus was occupied by an infected clot, the thrombosis was not an important factor in the patient's death, as the post-mortem re-

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† The writer has since operated upon a twelfth case in which a cholesteatomatous mass invaded the internal ear through the oval window, forming a cast of a portion of the labyrinth.

vealed the pathway of infection to be from the labyrinth along the course of the auditory nerve. The third death occurred in one of the sinus thrombosis cases and was due solely to the infective thrombosis. In this instance the jugular was occluded by an infected purulent clot which extended below the clavicle into the deep thoracic portion of the vein, it being impossible to get below the cardiac limit of the clot. In this instance the labyrinth was in a perfectly healthy condition and had been so for a period of over ten days before the development of the sinus symptoms. The first two deaths resulted from improper technique and the specific errors —for the sake of emphasis—will be referred to in their respective places. I regard these deaths as sacrifices which could now be avoided.

The labyrinthine capsule showed the following lesions:

In five, the only visible lesion was a loss of the prominence of the horizontal semicircular canal.

In one, the oval window was the seat of fistula through which granulations protruded. The vestibule, the semicircular canals, and the lower half of the first cochleal whorl were involved.

In one the prominence of the horizontal canal had disappeared. The oval window was perforated and filled with granulations; a second perforation was present through the centre of the promontory through which polypoid granulations sprouted and pus oozed. The canal system was filled with granulations, the vestibule and cochlea with granulations and pus.

In three, the horizontal semicircular canal had disappeared and the oval window was the seat of fistula and filled with granulations. The canal system, the vestibule and the cochlea were involved in each.

In one, there was a perforation just above the horizontal semicircular canal in the region of the solid angle. The inner vestibular wall was also the seat of a fistula which communicated with a large epidural cerebellar abscess in the vicinity of the internal auditory meatus. The entire labyrinth was involved in the purulent process, which had also destroyed the greater part of the petrous pyramid, necessitating its removal.

Of the 11 cases, therefore, the horizontal semicircular canal, either alone or in combination with other lesions of the capsule, was involved in nine.

The oval window was perforated in five; the promontory, or first cochleal whorl, in one.

The labyrinthine capsule in the solid angle of the semicircular canals in one.

The inner vestibular wall was perforated once.

In all, there were seventeen perforations in the eleven cases,—sixteen through the outer labyrinthine wall, but one through the inner. This is of surgical importance, and one of two conclusions is evident —either in the great majority of cases the labyrinth is invaded by direct extension through the capsule from without, or else the outer wall of the labyrinthine capsule is exceedingly more vulnerable than the inner. Both are true.

The cases show conclusively that the fistulous openings in the external capsule do not always represent avenues of invasion from without inward, but avenues of escape through which pus is successfully discharged from the labyrinth into the middle ear.

In every instance in which the vestibule has been involved the canal system and the cochlea—either in whole or in part—have been involved also.

The first question which from a surgical standpoint we are called upon to decide—and it is one with which we are frequently confronted—is the following: If after the diagnosis of labyrinthine suppuration is made we operate and find in the outer capsule of the labyrinth no fistula, shall we explore it upon the symptoms, fork tests, etc?

To take a correct surgical attitude with reference to this important point, we will consider first, briefly, the diagnostic value of certain chief symptoms and tests; second, the dangers which attend the exploration of the labyrinth; and third, the dangers which attend the non-exploration of the labyrinth. I trust that a brief reference to the surgical value of the first will not be misinterpreted, in the present paper which is concerned chiefly with the treatment of labyrinthine suppuration.

1st. In the vertigo, vomiting, nystagmus and disturbances of equilibrium of labyrinthine origin, there is nothing characteristic.

2d. Even if we can exclude cerebral and cerebellar disease and can fix these symptoms definitely upon the labyrinth, they are not indicative of actual invasion of the labyrinth; they merely signify disturbance of labyrinthine function; but this occurs with comparative frequency from causes entirely extra-labyrinthine: from polypi, cholesteatoma, pus in the middle ear under pressure, etc.

3d. The mere fact that these symptoms are associated with a suppurative process is of little diagnostic value, as the extra-laby-

rinthine causes which produce these symptoms by transmitted pressure are, as a rule, associated with a suppurative process also.

4th. Cases occur, presenting all the above symptoms and in addition fork tests, which, according to orthodox interpretation, point to labyrinthine involvement which when operated upon show no evidence of labyrinthine involvement in the outer capsule, and which completely recover without having the labyrinth explored; these cases are not uncommon.

5th. In my own cases the forks have been of doubtful value in differentiating middle ear from labyrinthine lesions.

Briefly: seven of the eleven cases lateralized to the side of labyrinthine lesion. In six bone conduction was not shortened in duration. Of seven in which the greater part of the entire labyrinth was removed, four not only lateralized to the side of the labyrinthine lesion and bone conduction was not shortened in duration, but by air conduction forks were heard throughout a considerable range of the scale.

6th. In every case in which I have seen the labyrinth encroached upon by either operation or disease, the organ has been rendered valueless for practical purposes of hearing. I refer also to several cases of acute mastoiditis in which I have seen the horizontal semicircular canal injured by accident, and which cases I have had the opportunity to examine.

7th. To expose the interior of a normal labyrinth to an infected cavity is highly dangerous to life. What the mortality is under these conditions, I do not know, as I am unacquainted with the literature of this subject; but from my own experience, I realize that the opening of a diseased labyrinth is a serious thing, and I am confident that it is far more dangerous to open a normal labyrinth in the presence of an infected cavity than a diseased one; for in the latter the pathways along which infection may travel to the intracranial cavity and sinuses have had the opportunity to become sealed through inflammatory processes.

8th. If we do not explore the labyrinth under the conditions mentioned, we may overlook certain cases of labyrinthine suppuration—for my own cases show conclusively that the labyrinth is not always invaded directly from without by encroachment upon the capsule, but that it may be infected by septic particles being transmitted to its interior along the avenue of the vessels, the outer capsule showing no perforation whatever, i. e., by a process of local metastasis. The pathological process is analogous to that in which

infection of the sigmoid sinus occurs from the antrum along the avenue of the communicating vessels, the intervening mastoid structure showing no apparent involvement.

Should we overlook such a case, we court two dangers:

1. Intracranial infection taking place along the communicating avenues with the labyrinth.

2. That the inner wall of the labyrinth will perforate before its outer wall.

With reference to the first: of the eleven cases mentioned, three had infective sinus thrombosis. This relative frequency throws some suspicion upon the labyrinth as a causative factor, for this proportion of sinus infections is entirely too high for the ordinary run of suppurative cases either acute or chronic.

That the infected labyrinth was responsible for one of the infected sinuses is probable, inasmuch as the symptoms of sinus involvement appeared six weeks subsequent to the cessation of aural discharge. This is suggestive of the role played by the communicating avenues from the labyrinth as infection carriers to the intracranial cavity, and the danger of overlooking such a labyrinthine suppuration.

The frequency with which the cerebellar fossa is found post mortem to be the site of greatest pathological activity in cases of purulent lepto-meningitis, originating from suppurative disease of the petrous pyramid is also suggestive of the important part played by the labyrinth as a distributing center of infection to the intracranial cavity.

With reference to the second—That the inner labyrinthine wall will perforate before the outer, is not borne out by clinical fact, nor, would we suppose it on anatomical grounds.

Of the seventeen perforations in the labyrinthine capsule in the eleven cases, sixteen were through the outer wall, but one through the inner wall. This ratio of sixteen to one is, of course, misleading, inasmuch as the majority of labyrinthine infections occur by direct extension through the capsule from without, under which circumstances the inner wall of the labyrinth is not subjected to a comparative test of vulnerability.

Considering, however, the doubtful value of symptoms as indicative of actual invasion of the labyrinth, the difficulty of eliminating cerebellar disease, the unreliability of tuning forks in differentiating in this class of cases middle ear from labyrinthine lesions, the practical certainty that we will destroy the organ for the purpose of

useful hearing, the actual danger to life should we commit the error of opening a normal labyrinth to an infected cavity, the certainty that the outer labyrinthine wall will in the great majority of cases perforate before the inner wall—the correct surgical attitude is, not to enter the labyrinth upon symptoms, etc., alone at the primary operation unless there is direct evidence that the labyrinth is involved. While I can imagine a combination of symptoms and circumstances which would cause me to open the labyrinth at the primary operation, even in the absence of recognizable labyrinthine invasion, I have as yet met no case which presented such features, and it is to be sincerely hoped that the labyrinth will not suffer the indignity of reckless exploration and that it will not be entered without a due consideration of the possible results to life.

What route shall we adopt?

The following facts have bearing upon the selection of the route by which we enter the labyrinth. From a surgical standpoint the cases may be divided into two classes.

Of the first class, the first five cases are illustrative, in which a loss of the horizontal semicircular canal represented the only lesion in the capsule. These cases represent caries of the labyrinthine capsule in which as the extension proceeds from without inward by a process of erosion, the limit to which the labyrinth is surgically involved is, as a rule, represented by the carious area. In such cases we merely remove the carious area and follow it to its limit, and the route which we select depends upon the site of the lesion, which, as a rule, is in the horizontal semicircular canal. The reasons for the frequency with which the horizontal canal are involved are evident.

1st. The external semicircular canal, unlike the posterior and superior canals which lie deeply embedded, juts out upon the floor of the aditus as a small ivory-like hump and is exposed to the suppuration process.

2d. Its exposure occurs at the point of greatest constriction between the tympanic and antral cavities, and at a point of great pathological activity. The canal is not only subjected to the action of pus but to the deleterious combination of pus under pressure.

3d. The aditus is an unyielding bony ring in the circumference of which the external semicircular canal represents one of its weakest points and it succumbs accordingly.

4th. The vulnerable point in the external semicircular canal is not at the extreme apex of its arch—the point of greatest exposure

—but at a point several millimeters below the summit of its ivory-like cap. This is due to structural differences at the points mentioned and to the fact that the base of this ivory-like hump is encroached upon or surrounded by a mass of cancellated bone which is easily disintegrated and in these cases always diseased.

I have seen no instance in which the extreme apex of the arch has been eroded: in every instance in which the canal has been involved the entire cap has disappeared.

In chronic suppurative cases we frequently have the opportunity to observe the effect of this undermining process as it has attained to different degrees of encroachment upon the lumen of the canal.

We find that the prominence of the canal presents at is base a thin, sharp edge so undermined that it would appear that by placing the finger-nail beneath it we could separate it as a little thin shell.

The manner of invasion in these cases is evident—the labyrinth is opened by a process of gradual erosion from without.

Of the second class, the remaining six cases are illustrative. In these the labyrinth is involved in a true suppurative process, and its various compartments are filled with granulations or pus, or both. These cases are in every way more formidable, more destructive and widespread, and more highly infective than the first and require bolder intervention. The vestibule is the site of greatest pathological activity, and in every instance in which I have found the vestibule involved, the canal system and the cochlea, either in whole or in part, have been involved also. This suggests the oval window as the most common avenue of entrance in the second class of cases, and this is in accordance with the pathological findings in the capsule as shown in the previous cases. In the true suppurative cases the oval window was perforated in every instance with one exception. We may also have in an individual case the two pathological processes mentioned at work at the same time.

Inasmuch, therefore, as the exploration of the canal system, involving to greater or less extent its sacrifice, is necessary in this class of cases, the route which we adopt resolves itself into the selection of that which from a manipulative standpoint is the most convenient, which least endangers the important structures in surgical relation, and which allows us to fully expose the limits of the disease. The only route which fully meets these requirements is posterior to the facial nerve, and the point through which it is safest to enter the labyrinth for reasons to be mentioned later, is the solid angle of the semicircular canals.

We prefer to enter the vestibule posterior to the facial nerve instead of anterior to it, for the following reasons:

1st. When the vestibule is involved the semicircular canal system, in the great majority of cases, is involved also. This necessitates its exploration, which entails its sacrifice.

2nd. The sacrifice of the canal system, even though it is not extensively involved, creates only an ephemeral disturbance, and adds no danger to life, as the canal system is not in important communication with the intracranial cavity except by way of the vestibule.

3rd. We secure the maximum amount of working room, the advantage of which can be appreciated only when we have attempted the actual operation; and we are better enabled to work in the axis of the petrous pyramid, which is the direction of greatest safety.

4th. We get a field unsoiled by blood and gain a clear conception of the condition within the vestibule, of the ampullary areas of the canals, and of the inner vestibular wall.

5th. The route anterior to the facial nerve does not permit an exploration of the canal system which we know as a rule to be involved, nor of the ampullary areas, nor of the major part of the inner vestibular wall, but only of its lower anterior portion—consequently fistulae through the inner wall of the vestibule may be overlooked; I have had one such case in which had I adopted the anterior route, I would have committed this error and sacrificed the patient.

6th. It is based upon the erroneous idea that drainage is the chief desideratum and will suffice. Mere drainage in this class of cases will not suffice, for not only is the interior of the labyrinth involved, but its capsule is, as a rule, profoundly diseased and such portions of it must be removed. In addition the complicated system of channels represented by the labyrinth cannot be satisfactorily dained from any one point, as from an opening in the outer vestibular wall.

That drainage through a given point will not suffice is shown by the fact that in many of these cases the outer capsule contained multiple fistulae—yet with multiple fistulae present, drainage was not accomplished. The mere existence of multiple fistulae, properly interpreted, is a plea for more efficient drainage than can be accomplished by this means. The attempt to drain the labyrinth through an opening in the outer vestibular wall, while it may in certain instances succeed, is comparable to the attempt to relieve cases of suppurative mastoiditis by merely opening the antrum. We

should make the effort to place the present operative procedure upon a thoroughly scientific basis from the first.

7th. From a manipulative standpoint the anterior route is far more dangerous; it is the more cramped; the anterior canal wall interferes seriously with manipulation in the upper portion of the cavity; we are working in a blind pit and are forced to do considerable work from without inward, the direction of greatest danger; first, as the dome of the jugular bulb may rise high, undermining the outer vestibular wall; and second, as the inner wall of the vestibule bulges outward at this point, making the anterior portion of the vestibule comparatively narrow from within outward, an injury to the internal auditory meatus is a much more probable accident.

What are the steps of the technique?

As a description of the complete exenteration of the labyrinth will embrace the various steps, that alone will be mentioned.

1st. A Schwartze-Stacke operation, by which we secure the maximum amount of working room, and in which we exenterate the bony angle included between the groove of the sinus knee and the under surface of the middle fossa, which better enables us to work in the axis of the petrous pyramid. We lower the facial ridge to its absolute limit, remove the fringe of bone on the anterior aspect of the facial ridge back to the descending limb of the facial nerve, remove the outer wall of the hypotympanum, and lower the level of the canal floor, securing by these steps the maximum exposure of the outer wall of the vestibule, and the dome of the jugular bulb should it rise high.

As exploration of the cochlea may be necessary, it is important that we see the exact position of the carotid artery by the exposure of its canal. In consequence we shave down the convexity of the anterior wall of the auditory canal, remove the lip of bone overhanging the mouth of the tube and evulse the tensor tympani.

This exposes the tube to curettement by which we relieve the field of blood, and it gives the maximum width to the apex of the cavity. Should the consistency of the bone permit, the arches of the semicircular canals should be delineated. This enables us to work with accuracy. (Fig. II.) The cavity should be cleansed; the tube packed with adrenalin gauze; the field rendered bloodless; the instruments and hands resterilized.

We next remove the prominence of the horizontal semicircular canal; it is a treacherous structure. The cutting edge of the chisel is placed at a point below the summit, but well above the level of

the fallopian canal, for this prominence separates along definite planes of cleavage, and as the outer lip of this semicircular canal is intimate with the fallopian, a fissure in the former may extend out into the latter. Should the plane of cleavage be on a level with or below the fallopian canal, the facial nerve may either be exposed by having its roof removed, as shown in Fig. X, or else completely undermined (Fig. V), under which latter circumstances we may definitely expect paralysis for it will ensue. The stroke should be made in a direction corresponding to the plane of the canal. The remaining canals are next uncapped, and the condition of the interior is noted. It will be found that the interior of the external semicircular canal most frequently of all shows pathological change. In opening the superior canal a curved gouge should be used. It permits the stroke to be made in the direction of safety. The danger arises from the non-support of this canal by solid bony structure.

Owing to the contrast between the dark interior of the canals and the brilliantly illuminated white bone surrounding them, the labyrinthine fluid may appear dark and be mistaken for blood or granulations; we should not be deceived by this illusion.

We next enter the vestibule through the solid angle of the semicircular canals by creating at this point a conical pit with its apex directed inward and gradually lowered until it enters the vestibule. As it is necessary to remove the inner lip of the horizontal semicircular canal, during this step the chisel should be held perpendicular to the plane of cleavage, and under no circumstances should it impinge upon the outer lip, which is intimately associated with the fallopian canal, together with which it is left as a bridge carrying the nerve which spans the vestibule. (Fig. IV.)

The opening in the vestibule is now enlarged until a full exposure is obtained of this portion of the cavity. Its inner wall should be searched for fistulae. In enlarging this cavity no pressure should be made upon the bridge. For this reason a curette is a dangerous instrument. A small sharp gouge is safer.

Owing to widespread necrosis, it is necessary in some instances to sacrifice the bridge of bone carrying the facial nerve. To accomplish this without injury to the facial, we select a curette with its cutting edge turned backward, utilize the superior rim of the bone cavity as a fulcrum and shave off from above downward in a direction parallel to the course of the nerve, the roof of the fallopian canal, thus leaving the nerve exposed in its gutter of bone, from

which it may be separated and lifted without injury. (Fig. VI.) Any filaments given off from the nerve should be cut and not torn from this structure, as unnecessary traumatism is committed. We next remove such portions of the bridge as are necrotic, but no more, for the nerve here represents a curve, and should it lose the entire support of its bony gutter, it apparently elongates and consequently sags or kinks and becoming enmashed in this vicious position by the granulations, has its functions interfered with later.

In this condition the nerve stretches as an exposed structure from its point of emergence low down on the facial ridge, across the cavity of the vestibule to its entry into the inner wall of the tympanus, corresponding to a point above and anterior to the original site of the oval window. (Fig. V.)

In knocking out the inner edge of the bony ridge, which corresponds to the upper inner wall of the tympanum, the stroke of the chisel should not be made from behind forward in a direction parallel to the course of the nerve, but from above downward, or, from before backward; i. e., in a direction perpendicular to the course of the nerve and to the fallopian canal.

The reason for this is that the bone at this point tends to separate when struck from behind forward, along a plane of cleavage which crosses the fallopian canal, causing its fracture; as the fallopian canal at this point represents the greater portion of an exposed cylinder (Fig. I), its fracture results in the facial nerve being encompassed by a little annulus or cylinder of bone, which may be slid up and down upon the nerve, just as a ring upon a finger. This complication is—so far as the integrity of the nerve is concerned—a formidable one, and it requires the greatest patience to remove the little annulus without causing injury to the facial. To accomplish it we steady the annulus with mouse-tooth thumb forceps and with a pair of ronguers—the jaws of which are accurately apposed—crush it in a direction parallel to the course of the nerve.

To avoid this complication, it is only necessary before attempting the removal of the upper portion of the bony ridge that the fallopian canal should have been thoroughly converted into a gutter, by shaving off its roof, as mentioned, and by making the stroke in the direction indicated. Should the accident now occur, the nerve can be easily freed from the little mass of bone by slipping it through the open side of the annulus, or cylinder.

Should we have to expose the nerve as mentioned and shown in Fig. V, no attempt should be made to retract it or draw it to

one side for the sake of gaining room for manipulation, as this is unnecessary; for the fallopian canal at the points at which the nerve emerges from and enters the bone is represented by sharp, serrated margins, against which if the nerve is drawn it may be lacerated at its fixed points. The sharp spicules should be removed so that the margin of the canal at these respective points is represented by an even rim.

The next step is to expose the anterio-inferior cavity of the vestibule by removing the posterior aspect of the promontory and the outer vestibular wall. (Fig. VII.) We select a gouge, the width of which corresponds to the distance between the round and oval windows. The cutting edge straddles the little bridge of bone separating these two openings, and the stroke—which is slight, for the posterior aspect of the promontory is brittle and fractures easily—is directed from above, downward and forward in the direction of the first cochleal turn. We must at this step think of the possible position of the dome of the jugular bulb.

The greatest care should be taken that the cutting edge of the chisel does not cross the cavity of the vestibule and impinge upon its inner wall, for the inner wall at this point bulges outward and is separated from the internal auditory meatus by a brittle partition of bone not more than 1-32 of an inch in thickness. (Fig. XVI.) Should the inner wall be fractured, we lose cerebro-spinal fluid and aside from the inconvenience caused by this accident, the infected operative cavity is placed in direct communication with the intra-cranial cavity and the patient's life is jeopardized; meningitis will probably result.

As the cerebro-spinal fluid is under pressure and is of low specific gravity, gauze does not act as an efficient plug to the rent; sterile wax is preferable.

By enlarging this opening, we secure, with the previous steps, the full exposure of the vestibular cavity and the beginning of the first cochleal whorl. Should we now find that the disease has invaded the cochlea, and this is the rule in the second class of cases, we must continue the exploration of the cochlea until we have followed the diseased process to its legitimate end.

We next remove the roof of the first cochleal whorl from behind forward, exposing its interior to a point just short of the carotid eminence. (Fig. V.) The instrument of preference is a thin, sharp gouge with no shoulder, the width of which is slightly greater than that of the cochleal whorl. Four structures are to be

avoided; the dome of the jugular bulb below, the eminence of the carotid canal in front, the base of the modiolus and the internal auditory meatus internally. The danger to the first two is slight; to the second two it is imminent, and injury to these structures is to be avoided only with the exercise of care.

By confining the removal of the cochleal shell entirely to the roof of its first whorl and not allowing the gouge to impinge upon the inner wall of the cochleal turn these last dangers may be averted. From the carotid artery in front, the cavity of the first cochleal turn is separated by a hard cuff of bone which serves the purpose of an efficient bumper: though thin this partition is sufficient. (Fig. XII.)

If we now find that the limit of the disease has not been reached, we must explore the remaining cochlea. This constitutes by far the most difficult and dangerous step of the procedure; for the cochlea, which represents an extremely small cavity encased in a brittle shell of bone, is hemmed in on all sides by structures which we cannot afford to injure. In front is the carotid artery, below the dome of the jugular bulb, behind the internal auditory meatus, above and behind in immediate proximity to the second half of the first cochleal turn, the knee of the facial nerve. A circle a quarter of an inch in diameter could be so placed as to pass through the majority of these structures.

Were the above factors the only ones to be considered, it would be comparatively easy to select a point on the cochleal shell, which from dead house work we had found to be a safe one, and open its cavity. But the difficulty lies in the fact that within this shell of bone is contained a structure which from its position is exposed to injury, and which from a surgical standpoint is the most treacherous of the internal ear; I refer to the modiolus.

Before approaching the cochlea it will be well to consider certain anatomical features of the modiolus which are of surgical importance. The modiolus represents a small pyramid of bone seated upon the internal auditory meatus, decreasing in size from base to apex. Its apex is its weakest point, but the next weakest point is not immediately below its apex, but at the extreme base; for its base is ex-cavated as shown in Fig. XI (Politzer), by the internal auditory meatus, and the pyramid consequently rests upon a mere rim of thin, brittle bone. If the chisel is applied to the pyramid well above its base and a stroke made, the fracture does not take place at the point of applied violence but at its base; when this oc-

curs the pyramid fractures completely round the circumference of its base and separates as a single piece of bone. (Fig. XIV.) The internal auditory meatus is consequently opened throughout its entire circumference, and as the diameter of the base of the pyramid, or the rim of bone upon which it rests, is about 1-6 of an inch, the loss of cerebro-spinal fluid is rapid. The failure to appreciate the surgical importance of this anatomical feature of the modiolus resulted in the death of the first patient.

If we now examine the modiolus with a strong convex lens we see that the pyramid has an outer casing of brittle bone and a core which is porous, made so by canals running from base toward apex for the passage of various structures. These canals are not completely filled by the structures which they contain, and this permits the cerebrospinal fluid to penetrate out into the modiolus.

During the second operation in which the modiolus had been removed well down toward its base it was noticed that a sepage of cerebrospinal fluid took place through its stump; the intra-cranial cavity had been placed in gross communication with the infected cavity in an altogether unexpected way through the afore-mentioned channels, and the failure to appreciate the significance of this structural character of the modiolus resulted in the death of the second patient. In this case the infection could be traced along the cochlear branch of the auditory nerve. It now became important to determine how far down from the apex toward the base the pyramid could be removed without putting the intracranial and operative cavities in gross communication; for in dealing with the anterior half of the cochleal cavity it is absolutely necessary to get rid of a portion of the modiolus.

It can be shown upon increasing the tension of the intracranial fluid in a cadaver by injection, or in the living subject by pressure over the internal jugular vein, under which circumstances the cerebrospinal fluid will penetrate as far out as possible into the modiolus (i. e., grossly), that the pyramid may be removed from the apex toward its base, down to a point corresponding to the termination of the first cochleal whorl without causing the loss of cerebrospinal fluid; i. e., without placing the operative and intracranial cavities in gross communication. As will be shown later, this suffices for the complete exploration of the anterior half of cochleal cavity.

In approaching, therefore, the cochlea, we must remove its shell in such a way as not to injure the modiolus. We select a point in

the cochleal shell corresponding somewhat to the apex of the cochleal cavity, and with a thin sharp gouge shave it down until the dark interior of a cochleal whorl shows through the thin lamella of bone. The stroke should be made from above downward and forward in a direction corresponding to that of a cochleal whorl.

Not infrequently the shell of the cochlea is scalloped and the position of the cochleal turns roughly indicated. In this way a window is created in the cochleal shell (Fig. X), and we now enlarge this window, completely exposing the upper portion of the cavity. (Fig. IX.)

In enlarging this window the small gouge is the instrument of preference; an attempt to insinuate a very fine curette beneath the opening in the cochleal shell causes its back to impinge or press upon the modiolus, which sticks up as a little tent pole in the cavity, and this may result in the fracture of the pyramid at its base. The gouge merely removes the shell without endangering the pyramid.

To expose the second half of the first cochleal whorl it is necessary to remove the apex of the pyramid down to a point corresponding to the termination of the first cochleal whorl, as shown in Fig. XII. This done, we can look down over the stump of the pyramid, upon the roof of the second half of the first whorl, which is indicated by the probe in Fig. XII, and with a small gouge carefully break through its roof from above as shown in Fig. XIII, exposing in this way the entire interior of the cavity of the cochlea. In breaking through the roof over the last portion of the first whorl we are in direct relation to the facial nerve and the internal auditory meatus, both of which must be avoided.

The probe in Fig. XII is wound round the base of the modiolus merely for the sake of illustrating the relations of the roof of the second half of the first whorl. An attempt to withdraw it may cause the modiolus to fracture; such a step, of course, would not be taken during actual operation.

In one instance I have had to exenterate the major part of the petrous portion of the temporal bone and the following points have impressed me:

1st. That the petrous pyramid in this particular instance was pneumatic; we would expect to find such extensive involvement only in bones of pneumatic structure for reasons which are evident.

2d. Where removal of the petrous pyramid is necessary it should first be exenterated; later the shell removed; otherwise the dura of the posterior and middle fossae bulge into the wound, constrict

the operative field which is extremely deep, and close it to successful view. Retraction of these structures is then necessary, but the best retractor is the shell of the petrous pyramid, as it commits no trauma, occupies no space, and is accurately applied to the surfaces to be supported.

A second reason for first exenterating the petrous is that the dura enclosing the superior petrosal sinus is firmly attached to the upper margin of the posterior aspect of the pyramid and separates with reluctance from this uneven lip. In consequence the vessel may be torn; sharp hemorrhage follows which is difficult to control, as it is not easy to place a compression plug between the dura and the bone, as the two do not readily separate. If the accident is to occur, it is more convenient that it should occur toward the end of the procedures.

We should attempt to save the facial nerve by preserving a bridge of bone extending from the lower portion of the facial ridge to the internal auditory meatus; with patience this may be accomplished and, in the instance mentioned, was accomplished. Even though the nerve be sacrificed, we should still attempt to preserve the bridge, the purpose being to give the dura of the middle fossa a seat upon which it may rest that it does not sag deep into the wound and become sealed in this position to the granulation bed springing from the floor.

When the dura is not supported it sinks and shuts off the apex of the operative cavity, rendering this portion difficult to handle, and it further obstructs drainage. No amount of pressure by packing with gauze suffices to maintain it in a proper position, as the gauze soon becomes soaked and its supportive influence lost. Should, for any reason, reoperation be necessary—and we must remember that dyscrasiae may underlie such extensive destruction, and portions of necrotic bone may remain which circumstances at the time of operation either cause to overlook or to abandon—the dura sealed in its vicious position constitutes an efficient barrier to further operative interference. For this reason the operation should be thorough and all dead bone in the deep, apical portion of the pyramid removed. When the bridge is sacrificed the nerve, which represents a curve, is exposed over a considerable portion of its length and it kinks and becomes enmashed later in the granulation bed; this interferes with function.

It is dangerous to attempt to remove sclerotic portions of the pyramid with the rongeur. The force requisite for a bite of the

forceps is great, the bone suddenly gives and as the jaws of the rongeur spring together, sharp slivers of bone are thrown with violence against the tightly stretched dura of the cerebellum, which makes an excellent target to be perforated. I have seen the posterior fossa opened in this way.

It is highly important to be familiar not only with the surgical anatomy in the operative position, but to know the consistency of the bone; to know the result that will follow a stroke of the chisel when made in a definite direction; for the bone of the petrous pyramid is structurally treacherous, changing rapidly from pneumatic to absolutely sclerotic structure, which may crack when struck far beyond the point of applied violence and in a direction contrary to that expected. We can obtain a practical familiarity with this important part of the technique only by repeated work upon the cadaver, and an attempt at a description of this part of the technique is useless. Generally speaking, we should, when attempting to remove sclerotic portions of the labyrinth, make the stroke in the long axis of the cavity which the sclerotic bone covers. While this is not invariably true, it is as near as the facts can be reduced to rule.

In operations upon the labyrinth a point of interest is to be noted with reference to the carotid artery, when through erosion of the carotid canal the artery is exposed to view, there is, as a rule, no visible pulsation in the vessel; I have seen the artery exposed in eight cases (some in chronic suppuration), and in only one instance was pulsation to be detected. If pressure is made upon the vessel with an applicator wound with cotton and the lumen of the vessel momentarily constricted, slight pulsation may be elicited. It is a wise provision that the vessel does not forcibly pulsate at this point and impinge upon the sharp serrated margin of the eroded canal; the walls of the artery in the canal are thin owing to a lack of the necessity for their full development.

The carotid canal serves a two-fold purpose: First, As the exposed artery in the canal shows no visible pulsation, or but a faint pulsation, it is evident that the carotid canal acts as a bumper to the pulse wave, diminishing its impact and shielding the brain from excessive shock.

Second, As the canal is rigid and does not permit the artery to dilate except within narrow limits, it has the practical effect of constricting that portion of the artery within its grasp. The effect is the same as when with the fingers we constrict the lumen of a rubber tube through which water is being forced by a rubber bulb, i. e.,

there is a tendency under these condition for the intermittent or remittent current to approximate a continuous stream. The carotid canal, therefore, not only protects the brain from excess of pulse impact, but it is a mechanism by which the inflow of blood to the brain is somewhat regulated and made more even and continuous. It is analogous to the hydraulic arrangement of the jugular bulb and sigmoid sinus on the venous side of the circulation, whereby an even outflow of blood from the brain is guaranteed.

During and following operation upon the labyrinth certain phenomena occur which are of exceeding interest.

If during anaesthesia we produce intermittent pressure upon the capitulum of the stapes, we may in certain instances induce nystagmus, which—should it occur—would rather point to the fact that the labyrinth is functionating and not grossly involved in a destructive process. This experiment may prove of some value from a diagnostic standpoint in determining labyrinthine involvement, when the capsule shows no fistula.

If during operation we irritate with a probe the interior of the semicircular canals we may at time induce nystagmus. In the cases which I have seen the nystagmus has been bilateral and in the horizontal plane, regardless of which canal was irritated. The irritation of the inner vestibular wall gives a similar result.

The ampullary areas of the semicircular canals are more sensitive to irritation than their arches.

The upper posterior portion of the inner vestibular wall appears to be its most sensitive part.

A nystagmus which prior to operation is very marked may not disappear under ordinary surgical anaesthesia until the semicircular canals are removed and the vestibule opened, when it may entirely cease.

If the horizontal semicircular canal is by accident injured as during the acute mastoid operation, vertigo, vomiting, and nystagmus may appear and may be marked; again, these symptoms may be entirely wanting. As a rule, the disturbances which follow the injury are exceedingly slight and ephemeral, and consist of horizontal nsytagmus—most marked when the eyes are directed to the opposite side, and slight vertigo with a tendency on the part of the patient to fall away from the labyrinthine lesion. Profound disturbance of hearing, as a rule, follows.

If the operation has encroached to any extent upon a functionating labyrinth, particularly in cases where both the canal sys-

tem and the vestibule are removed, disturbed equilibrium, nystagmus, and vomiting, which is accompanied by nausea, as a rule, follow. The vertigo is more pronounced when an attempt is made to assume the sitting posture, and closure of the eyes augments the disturbed equilibrium. The patient, as a rule, tends to fall to the side opposite the labyrinthine lesion.

At first the nystagmus may be of marked rotary character—the globes rotate beneath the closed lids, and nystagmus is independent of an attempt to fix the eyes upon an object. Nystagmus may be present in whatever direction the eyes assume. In a few days a marked decrease occurs, and as a rule, though not always, the greatest excursion of the globes is in the horizontal plane. At first the oscillatory movements may be fine; later they are coarse, sluggish and jerky. The apparent fineness or coarseness of the movement appears to be dependent upon the rapidity of oscillation. The nystagmus, as a rule, presents the following features:

1st. It is most marked when the patient looks to either the extreme right or left lateral position.

2d. When the eyes are directed to the upper vertical meridian, slight nystagmus may be observed, which, at first may appear vertical in direction, but upon careful inspection a slight rotary movement will be seen. This latter is possibly due to the action of the extrinsic muscle of the eye.

3d. When the eyes are directed to the lower vertical meridian, the nystagmus is slightest, and, as a rule, absent, even though present in other meridians.

4th. The nystagmus is most marked when the eyes are directed to the extreme lateral position of the normal side. Even after the nystagmus has totally disappeared in all other meridians, it may still be made manifest when the eyes are turned from the labyrinthine lesion. Occasionally the patient tends to fall to the side of the labyrinthine lesion and not to the opposite side. When this occurs, the nystagmus may be most marked when the eyes are directed to the extreme lateral position of the operated side, or equally as marked as when turned to the normal side. There appears to be some harmony, as to direction, in which disturbed equilibrium and nystagmus are most manifest.

The vertigo and vomiting which follow operation upon the labyrinth, cease, as a rule, in a few days, and disturbed equilibrium and nystagmus soon subside. The patient, however, when attempting to walk a straight line, may show for some weeks or months sub-

sequent to operation a tendency to deviate from the involved side; he may so tend to fall immediately after operation. In other cases all disturbances of equilibrium disappear in a few days. This tendency to fall or to deviate from the side of the labyrinthine lesion occurs in cases in which the horizontal canal alone is removed, in which the canal system and vestibule are both removed, or in which the entire labyrinth is removed. In some cases a slight nystagmus may be observed months after the operation; it may persist for years.

In some instances where the nystagmus is not of sufficient degree to be manifest when the eyes are directed to infinity, it may be made so by having the patient suddenly converge and accommodate, though this is not the rule.

The primary direction of the oscillatory movements is away from the labyrinthine lesion, i. e., if the left labyrinth is involved the direction of oscillation is from left to right, or vice versa, no matter in what direction the eyes are turned; I have seen no exception to this.

The nystagmus and vertigo as above described are in no sense characteristic of the labyrinth; I have seen the same phenomena occur in cerebellar abscess, the location of which was in immediate proximity to its central lobe.

Upon the removal of the semicircular canal system, the vestibule, and the lower half turn of the first cochleal whorl, I have seen nystagmus, vomiting, vertigo, disturbed equilibrium, and intense high-pitched hissing noise, which were distressing before operation, immediately cease.

As to why the destruction of the semicircular canal system and vestibule may in the one instance be productive of vertigo, vomiting, nystagmus and disturbed equilibrium, and in the other cause these same symptoms to quickly disappear, I do not know, but even where these symptoms follow operation upon the labyrinth and are marked, they, as a rule, so quickly subside that it is evident first, that the semicircular canal system is not an indispensable factor to the preservation of equilibrium; and second, that we can scarcely attach to it the importance of being the central organ of the statical sense, as its loss can be so quickly compensated for and in some instances seem to produce no disturbance whatever; it evidently is a part of more or less importance in the great circuit governing equilibrium, but it is by no means an indispensable part, nor is the entire labyrinth indispensable.

Following the removal of the major portion of the labyrinth, conjugate deviation of the eyes may occur, the direction assumed being

upward and outward toward the operated side, as if the eyes were attempting to see the labyrinthine lesion. It should be mentioned, however, that in the two cases in which the phenomenon was observed, cerebro-spinal fluid was lost in both. This suggests that the conjugate deviation may have arisen from other causes than the destruction of the labyrinth. The conjugate deviation was noticed immediately upon the patient's emergence from anaesthesia.

Following the removal of the deep portion of the petrous pyramid, we may notice upon the patient's emergence from anaesthesia that both pupils are dilated ad maximum. This dilation probably results from disturbance of the sympathetic, at the deep, apical portion of the pyramid.

The pupils, though dilated ad maximum, may react to both accommodation and to light. The dilatation gradually disappears after several weeks.

Following the exenteration of the petrous portion of the temporal bone, probing or pressure in the immediate vicinity of the stump of the auditory nerve may produce vertigo, nystagmus, and the subjective phenomenon of intense noise, which noise is referred to in the involved ear. The trunk of the auditory nerve is capable of interpreting mechanical stimuli, as sound, and from the case which I had the opportunity to observe, I am inclined to believe that the trunk of the auditory nerve is also sensitive to waves of sound.

Following the exenteration of the labyrinth, the patient may be exceedingly sensitive to noise and to loud musical sounds. The sense of harmony may be lost and after several months regained. The patient, if subjected shortly after operation to loud musical sounds, as the playing of the piano, may become intensely dizzy, the vertigo attaining to such a degree that it necessitates his sitting that he does not fall.

It would appear that we receive through the auditory apparatus certain physical impressions which, when transmitted to higher centers, act as supporting influences to the preservation of station; that these, when not balanced by similar impressions acting upon the other ear cause, so to speak, an auditory imbalance; that the disturbance is due to the lateralization chiefly to one side of those impressions, which give rise to the subjective phenomenon of sound is questionable, inasmuch aas the patient who was totally deaf before operation experienced then no such disturbance under similar conditions.

The phenomenon is suggestive of the great variety of factors which may act through the medium of the auditory apparatus and

quickly disintegrate and completely disappear. The nerve should contribute to the preservation of that condition which we speak of as the state of equilibrium—it gives us an insight into the intricacy of the function of the auditory apparatus.

Following the removal of the entire labyrinth, tinnitus may still persist in the involved ear; its character, however, may completely change, and in all the cases the tendency has been—even where the tinnitus before operation was intense and of high pitch—for it to assume a low, buzzing, inoffensive character after operation. Later the tinnitus may entirely cease.

When the facial nerve is exposed throughout its entire circumference, we may with confidence look for paralysis upon the patient's emergence from anaesthesia. The paralysis deepens and in forty-eight hours becomes complete. It persists from four to five months, even though no injury is done the nerve other than its exposure to the wound and its fluids, and though the reactions of degeneration may appear, the face under massage, and with time, regains its nearly normal expression; I have seen, however, no case in which the function has been so completely restored that the variation in the two sides could not be detected upon the act of smiling. When the nerve is exposed in the manner mentioned, it is difficult at the time of operation to make it respond to ordinary mechanical stimulation, and moderate heat does not affect it.

The facial nerve is structurally very delicate. I have seen a nerve after several days' exposure to an infected cavity which had been irrigated but twice with a 1-10,000 solution of bichlorid of mercury, be protected by sterile vaseline and subjected to no pressure by the packing and the dressing should be changed sufficinetly often to keep the cavity clear of pus.

Subsequent to operation, meningitis may occur. It manifests itself in from forty-eight to seventy-two hours. It is characterized by the usual features, with the exception that the sensorium is remarkably clear till near the end; the termination is rapid. Though the postmortem may show a diffuse leptomeningitis, the cerebellar fossa is the site of greatest pathological activity. The route of invasion may be apparent, and in one of my own cases was along the course of the auditory nerve.

When the internal auditory meatus is opened, the rapidity of escape of cerebro-spinal fluid suggests the proximity to the canal of large quantities of cerebro-spinal fluid, as if the cerebellar fossa contained or was in direct communication with a relatively great

amount. In the period of approximately a minute, the cavity represented by the Stacke-Schwartze excavation may fill as many as three times.

Following the too rapid drainage of the cerebrospinal fluid from the cerebellar fossa the following symptoms may appear: a small, rapid, irregular pulse; embarrassed respiration, which may assume a Cheyne-Stokes character; an anxious, concerned expression, with cold extremities and pinched, livid features; marked restlessness.

These symptoms may be of such alarming character that death seems imminent, but with a lessening of the escape of cerebro-spinal fluid the whole picture may in the course of a few hours so completely change that the patient appears quite normal. These symptoms are undoubtedly due to a too rapid drainage of the water-bed of the brain, whereby the important nerve centres at the base, having lost their elastic support, sink and are brought into undue contact with the floor of the skull.

The quick disappearance of these symptoms upon the cessation of the escape of cerebro-spinal fluid forbids any other than a mechanical interpretation.

Following operations upon the labyrinth, large quantities of sugar and acetone may appear in the urine, and the clinical picture of diabetes may rapidly develop. These phenomena suggest that operation upon the labyrinth may be productive of a profound systemic shock which does not manifest itself in the usual disturbances of temperature and pulse. The causative relation, however, between shock and diabetes is highly suggestive of the major character of the labyrinthine operation.

In three cases where the major portion of the entire labyrinth was removed, including the semicircular canal system, there appeared to be after a lapse of over two years in the first, one year in the second, and nine months in the third, no sign whatever of muscular atrophy of either side of the body.

Where the destructive process in the labyrinth has existed for a long time and the irritative stage is passed, the organ, so to speak, is functionally silenced and shows no sign of life; its exenteration is followed by no disturbance whatever of equilibrium; no vomiting, vertigo, or nystagmus occur, as the compensating factors, whatever these may be, have made good the deficiency.

That the disturbance of equilibrium, nystagmus, etc., which follow the removal of portions of the labyrinth are due, to some extent, to the loss of these parts is highly probable, inasmuch as these symp-

toms continue, even though the interior of the labyrinth is thoroughly cocainized. That these symptoms, however, are not altogether due to the loss of these parts is evident, inasmuch as under anaesthesia, mechanical irritation of the interior of the vestibule may produce nystagmus, as may also pressure upon the ampullary areas of the semicircular canals. Pressure upon the stapes may give a similar result. Further, if we irritate with a probe certain portions of the labyrinth subsequent to operation, we may in some instances cause the patient to fall, by producing an intense vertigo. Nystagmus may also be induced or augmented by pressure over certain areas. It is highly probable, therefore, that the disturbances of equilibrium which follow the removal of portions of the labyrinth are due not only to the loss of the parts destroyed but also to peripheral irritation, to which the interior of the labyrinth is subjected. It is only upon this double basis that we can explain certain phenomena in connection with these cases.

For instance, in Case X of the writer's series, disturbed equilibrium, vertigo, vomiting and nystagmus which were intense and distressing before the operation, immediately ceased upon the removal of the semicircular canal system, the vestibule and the lower half of the first cochleal whorl. If, therefore, these disturbances are due to the non-activity of the canal system, and not to irritation, why should the patient when in possession of these parts have exhibited intense disturbances of equilibrium, and after their removel, which insured their non-activity, have shown no disturbances of equilibrium whatever?

Following operation upon the labyrinth, the pulse may be both irregular and rapid and this disturbance may be independent of the loss of cerebrospinal or labyrinthine fluid; the condition soon rights itself.

From the following facts certain conclusions may be drawn, which are of some practical interest in that they show the difficulties attending labyrinthine localization. If we remove the arch of the horizontal semicircular canal, there may follow, vertigo, vomiting, nystagmus and disturbed hearing.

The removal of the entire canal system and the vestibule may be followed by the same phenomena.

The accidental removal of the stapes may produce vertigo, vomiting, nystagmus, disturbed equilibrium and disturbed hearing. The destruction of portions of the vestibule and cochlea without destruction of the canal system produces the same phenomena. It is now

evident that if we deny to these various phenomena, representing several different functions disturbed, the entire labyrinth as the anatomical seat of each (for these phenomena follow no matter what portion of the labyrinth is destroyed) we are led to the following conclusions, which seem to be supported by clinical evidence:

1st. That if the integrity of the labyrinth is encroached upon at any point, the function of hearing, as well as the non-acoustic functions, is seriously interfered with.

(If the encroachment has been gradual and there is no apparent disturbance of equilibrium, etc., it is due to compensation.)

2d. That the disturbances which follow the destruction of a given portion of the labyrinth are not necessarily to be attributed to the loss of the parts destroyed.

3d. That the destruction of the labyrinth at a given point affects the function of distant parts as well. If, for instance, we destroy the entire labyrinth with the exception of the cochlea, or, if we merely remove the arch of the horizontal semicircular canal, we are at a loss to know whether to attribute many of the disturbances which follow to the loss of the parts destroyed or to the irritation of the parts remaining.

It therefore follows that an attempt at labyrinthine localization based upon symptoms will always be subject to the grossest error, and that the attempt to determine the functions of the various departments of the labyrinth by the experimental destruction of these will be subject to the same error.

The difficulty of experimentally determining with accuracy the functions of the various parts of the labyrinth with a view to labyrinthine localization, and this is here alluded to merely on account of its surgical interest, is due in large measure to the anatomical arrangement of the labyrinth, the essential feature of which is, that it is suspended in a fluid medium which is *continuous*. A disturbance of the medium at any point is transmitted throughout the entire apparatus and results in the disturbance of distant parts.

While this particular anatomical arrangement complicates the study of the physiology of the labyrinth, it is an essential attribute of an organ which embraces several distinct and separate functions, which are correlated to the extent that each is influenced through the same common medium and to some extent by the same primary cause —waves of sound.

The labyrinth is an example which illustrates the conservation of energy in the evolution of an organ in that the anatomical bases of its

several functions, which in reality represent different organs, should have been so grouped together and suspended in a common medium as to make common use of that medium. This arrangement is evidence of the influence which waves of sound exert upon the non-acoustic as well as upon the acoustic labyrinth and a practical example of this is illustrated by the case previously mentioned where the patient when subjected to loud musical sounds, after the exenteration of the entire labyrinth, was made so dizzy as to necessitate his sitting, his equilibrium having been profoundly disturbed.

While it is the purpose of the present paper to treat of only those conditions which have a surgical bearing, there are many facts in connection with the cases which are of interest in that they are in contradiction to certain theories which have gained a more or less widespread acceptance.

44 N. 49th St.

A Case of Nasal Hydrorrhoea Cured by Electrolysis. DR. VALENTIN. *Le Nord med.*, Jan. 15, 1906, No. 271.

Valentin reports a case of nasal hydrorrhoea in a patient at the menopause. Spraying with cocaine and stovine was without effect as well as constitutional methods such as strychnine and atropine. The application of electrolysis, however, was followed by a complete cure. SCHEPPEGRELL.

Massage of the Stapes. TREITEL. *Arch. f. Ohrenh.*, Leipzig. Oct., 1904.

In two cases, massage of the stapes with the Lucae's pressure probe resulted in remarkable improvement of the hearing, lasting several years. YANKAUER.

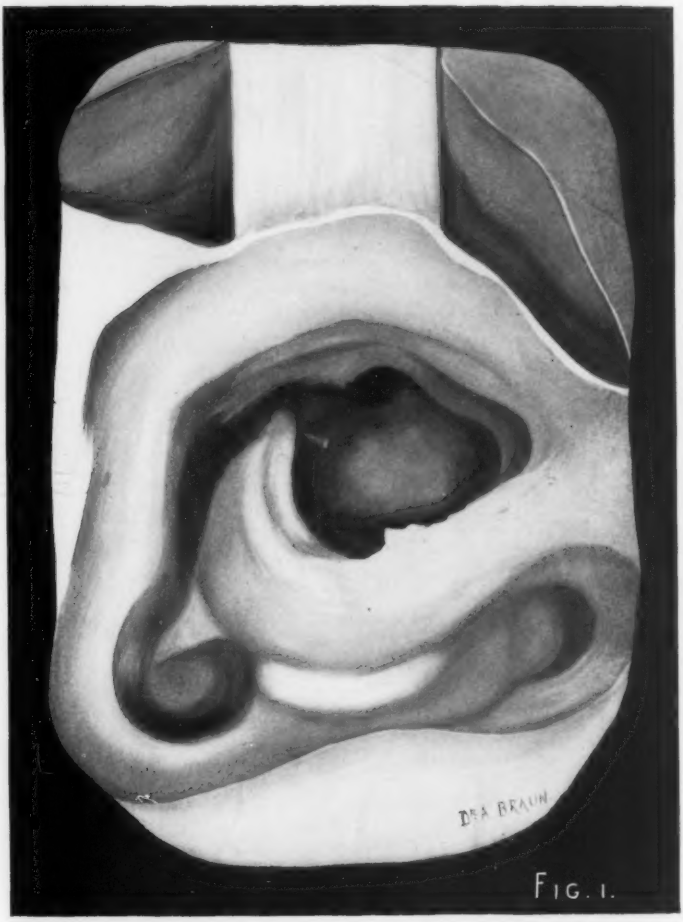

FIG. 1.

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FIG. 11

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FIG. III

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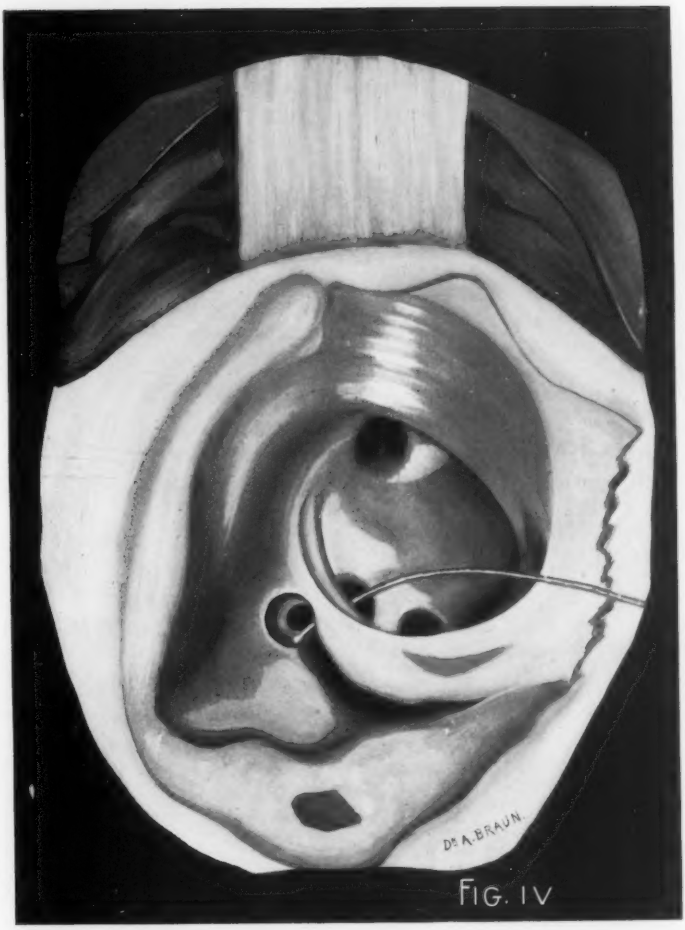

FIG. IV

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FIG. V

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FIG. VI.

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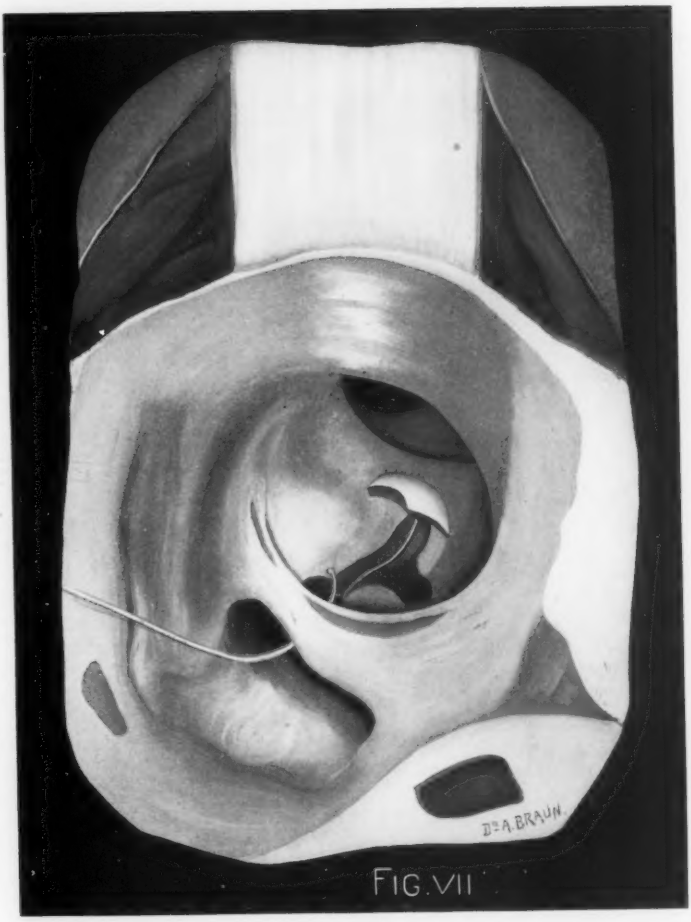

FIG. VII

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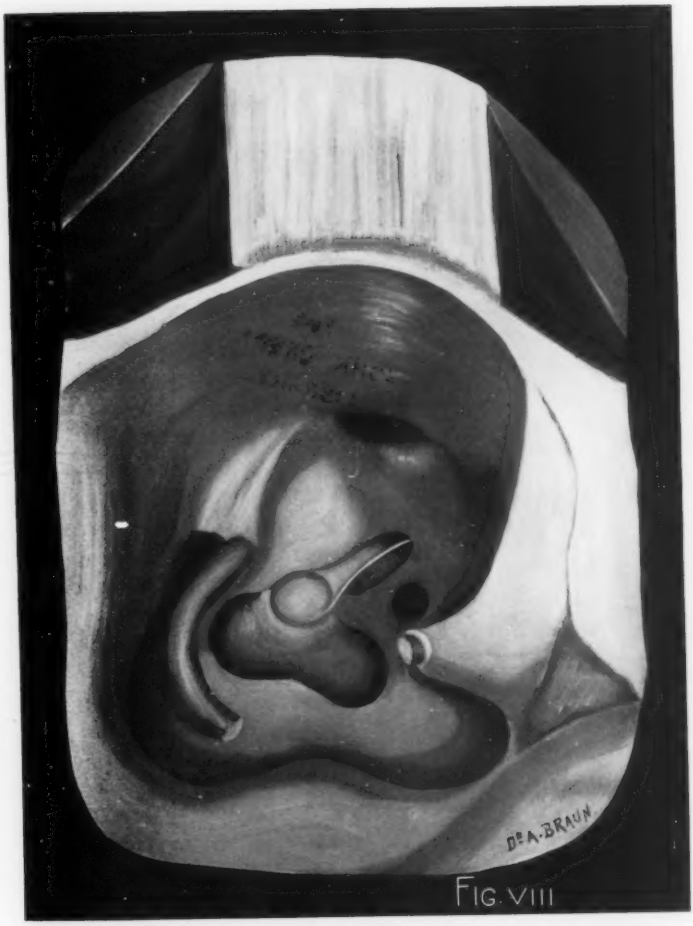

FIG. VIII

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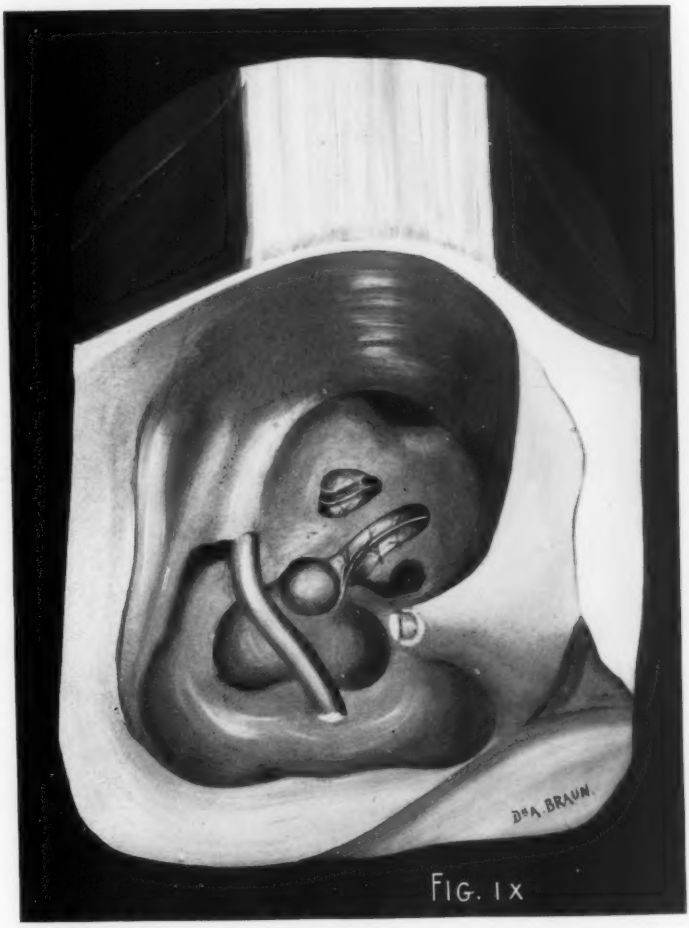

FIG. IX

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FIG. X

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FIG. XI

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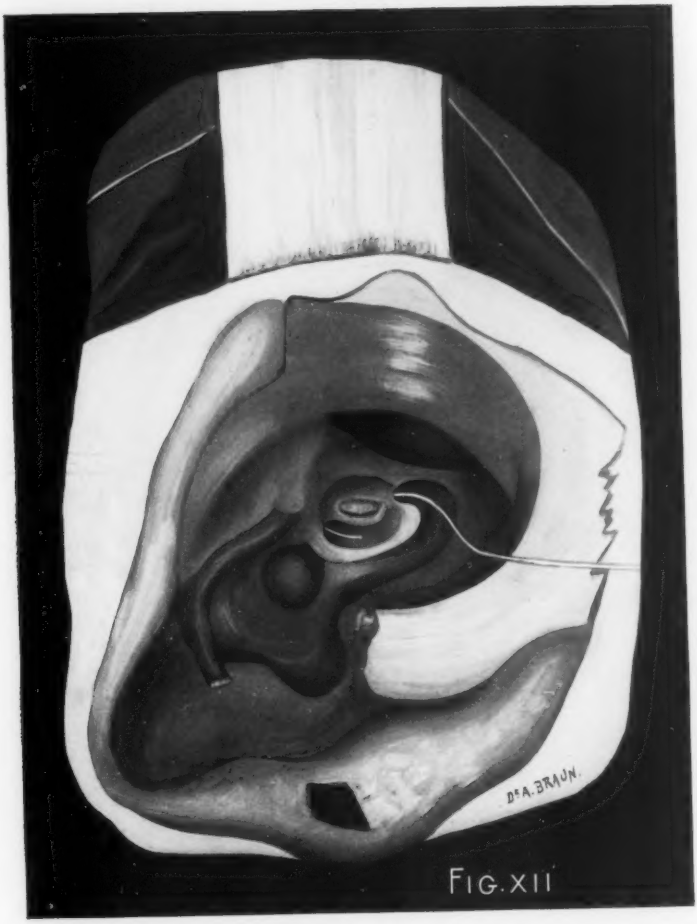

FIG. XII

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FIG. XIII

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FIG. XIV

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Fig. XV

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FIG. XVI.

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A PLASTIC OPERATION FOR THE CLOSURE OF SEPTAL PERFORATIONS.

BY BURTON HASELTINE, M.D., CHICAGO.

Perforation of the nasal septum is a condition the importance of which is variously estimated. In the past it has been considered by most rhinologists as negligible and even in some instances as a desirable condition. There are text-books still in use which advise the making of perforations in some forms of nasal stenosis.

This wilful substitution of two deformities for one could probably find no advocates today, but current writers seem to agree that in correcting septal deformities by any method a certain percentage of subsequent perforations is to be expected. Cases are even exhibited as successful in which such accidents have occurred. This is a mistaken attitude destined soon to become as archaic as the plan of deliberate puncture. A post-operative perforation marks the surgical tyro and is no more excusable than any other evidence of bungling.

If discredit to the surgeon were the only unpleasant result of this condition it would be of little consequence; but such is not the case. In almost every instance, chronic ulceration takes place along the margins of the opening with crusting, bleeding and foul odor, requiring constant attention from the patient and subjecting him to great annoyance. As the erosion progresses the opening increases in size and in time comes to resemble that due primarily to ulcerative processes.

It is a question whether non-luetic disease of the septum can go to the extent of changing the external conformation of the nose; but it is my belief that in neglected cases this can occur. Certainly such deformities do exist where no luetic signs can be discovered, and the theory that spontaneous perforation necessarily means syphilis is no longer tenable.

Without attempting to magnify the seriousness of a small defect, it must be conceded that septal perforations are undesirable and if a suitable method for their permanent closure can be devised it will deserve a place among recognized surgical procedures. Heretofore this seems to have been universally regarded as impossible, but recent improvements in intra-nasal surgery have suggested to several men its feasibility. Goldstein of St. Louis was probably the first

publicly to suggest a plan. At the June, 1906, meeting of the American Laryngological, Rhinological and Otological Society, at Chicago (Middle Section), he described his clever device for covering the denuded edges of perforations and made a preliminary report of some experiments looking toward their closure. Yankauer of New York in the Laryngoscope for February, 1907, describes his ingenious method of sewing the mucosa and mentions two septal perforations successfully closed. This, I believe, is thus far the only published report of a case. Andrews of Chicago, in a personal interview recently, told me of having closed a small opening by a mucous flap and no doubt others are experimenting along this line.

All attempts heretofore reported have been by the making of a single mucous flap. This plan is necessarily limited to the closure of small perforations and even in these offers no great certainty of success. As the method which I have devised is radically different from those tried by others I will report my experience in some detail.

Up to the present time I have made six operations for the closure of septal perforations. One was a total failure, one a partial success and four were entirely successful. My first attempt was in the autumn of 1905 and was a failure. The patient had a narrow opening about ten millimeters long near the nasal floor, evidently due to the saw cut of an operation by the Gleason method. I resected the deformed cartilage and closed the opening by a flap from above brought downward and stitched along its inferior border. This was not a difficult procedure, as the opening was so placed as to be readily accessible and there was plenty of tissue to cover it. This flap was attached only at its posterior end, but with excellent approximation supported above by cartilage and with no tension, I expected a good result. I was, therefore, disappointed in a few days to find the flap sloughing and all the membrane edges curling away. The final result was an opening larger than before.

A result so different from those achieved by similar operations elsewhere led me to look for the peculiar conditions that produced it and these I found without much difficulty. First, I considered the blood supply and saw at once that I had violated the first rule of plastic surgery. The chief arterial supply of the anterior septum is the septal branch of the superior coronary and from this my flap was wholly separated. Its second supply is the superior palatine through the foramen of Stenson and this, too, was cut off. Its third and only remaining supply is from the nasopalatine branch of the

internal maxillary, running forward and downward near the upper margin of the vomer, and for this I had shown little regard.

I next studied the histology of reparative processes and learned that the septal flap is almost wholly devoid of the necessary connective tissue element. This explains why unsupported mucous membranes, however carefully approximated, will utterly refuse to unite. It also explains the inability of the septum to fill the smallest perforation by a granulating process. A small hole at the close of an operation means a larger one later, which is only increased by any effort at "stimulation."

I recognized, too, that septal cartilage is worse than useless in any effort at repair. A non-vascular tissue nourished by its coverings, it dies when exposed and instead of a support becomes a burden. Lastly, septal flaps are delicate, holding stitches poorly, and are incapable of bearing more than the slightest tension. The mere drawing of sutures through the membranes will often lacerate them seriously.

An operation to have any wide application must overcome all these difficulties. The following, therefore, are imperative requirements:

I. To conserve the bloody supply.

II. To provide a double flap for the aperture with an intact membrane under every seam.

III. To leave no denuded cartilage. Denuded areas must be of bone or vascular tissue.

IV. To require few stitches which must be easily inserted and produce no tension.

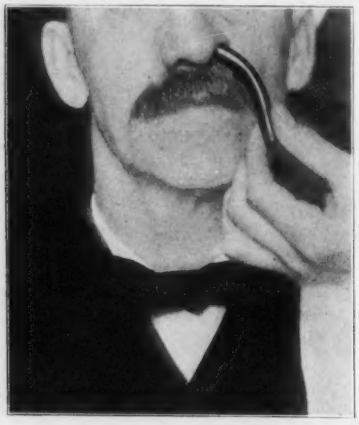
The operation to be described seems to meet all these requirements and has given me complete success in four cases. In one other it was almost equally successful, but a tiny opening at the upper apex resulted from too early removal of support.

The first successful operation was made in July, 1906, and shows a perfect result after fifteen months. It was a perforation very similar to the one above described, due to a sawing operation made by myself three years before. The second was made in October, 1906, and was equally successful. This was a post-operative aperture six millimeters in diameter.

Encouraged by these results, in December, 1906, I operated for the closure of an idiopathic perforation which was large enough to admit the end of my index finger as far as the first joint. There was a suspicion of syphilis in this patient, but no clear history could be obtained. Iodides were given three weeks before the operation

and for several months afterward, or as long as the patient could be kept under observation. When last seen the septum was in perfect condition with no ulceration or odor.

In my last case, the operation was subjected to the severest test and the result seems to positively establish its value. The patient, a man of forty-two, had a perforation which included almost the entire cartilaginous septum. Its posterior and inferior margins were bony and only narrow strips remained of the anterior and superior



cartilage borders. The opening was irregularly oval with a long diameter of one and one-half centimeters. A hard rubber tube, one centimeter in diameter, was passed through and did not fill it. A photograph showing such a tube in this position is reproduced herewith. No definite etiology could be determined in this case, but a luetic origin was suspected and the patient was so treated both before and after operation.

The patient was referred to me by Dr. Carlton A. Harkness of Chicago, at whose request I undertook the manifestly difficult task of restoring this septum. This was done on August 26th before several visiting rhinologists, to whom I am indebted for helpful suggestions and for the patience shown in witnessing a most prolonged and tedious operation. It was found to be impossible to use even the ordinary sutures in this case, as number three braided silk would cut through in forming a knot. A single suture was left at the highest point on one side and elsewhere the flaps were simply

smoothed out with the spatula and held in place with delicate lint pads. Moderate pressure was made from either side with Bernays sponges. This was lessened daily until the fourth day, when both sides were uncovered and examined. There was absolute closure at every point with no sign of retraction or of slough. The denuded areas were covering rapidly, the one in front having almost disappeared. The septum was supported by dressings in one side changed daily for three weeks, after which it received no attention except cleansing. The result is an imperforate septum quite normal in appearance.

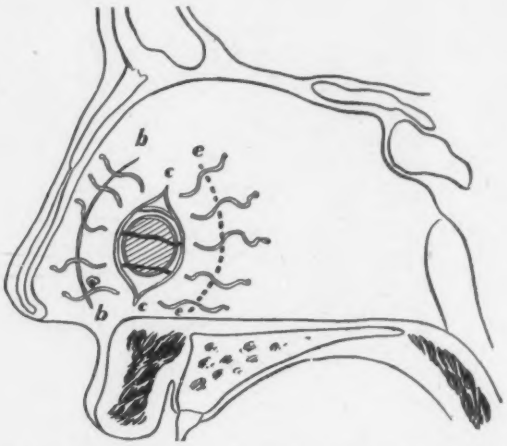


Fig. A. General schema of the operation. b b, The incision anterior to the perforation. c c, The freshened edges of the perforation. e e, Posterior incision upon the opposite side of the septum. The sutures are shown in position.

TECHNIQUE OF THE OPERATION.

(1) The edges of the opening are carefully pared and V-shaped sections are removed above and below to allow approximation of the vertical margins without wrinkling. This is done with scalpel or with the Ballenger single-tine swivel knife.

(2) A vertical incision is made in the *septum mobile* and a flap is lifted backward to, and entirely around the perforation. This incision is placed far forward to make the widest possible flap anterior to the opening. It should extend upward to the nasal roof and downward into the floor, and it is well to include in the flap some of the underlying cellular tissue. The elevation should be car-

ried along the nasal floor to a point as far backward as the posterior border of the aperture.

(3) The muco-perichondrium of the opposite side is elevated entirely around the perforation and the bone or cartilage of its immediate border is removed. The swivel knife, bone forceps and chisel may all be useful here. The muco-periosteum of the distal side back of the opening is now elevated as for an extensive bony resection. This elevation must extend to the roof and into the nasal floor.

(4) A vertical curved incision with its concavity forward is made through the distal membrane far enough behind the aperture

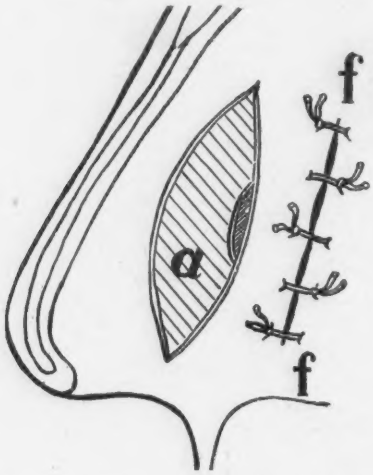


Fig. B. a, The denuded cartilage after the anterior flap is sutured to the mucous membrane of the posterior margin of the perforation. f f, The suture.

to produce a flap wider than its anterio-posterior diameter. This flap must be loosened until it can be drawn forward and sutured to the anterior margin on the same side, or better still, overlapped without sutures.

(5) The proximal flap is slid backward to meet the posterior margin if possible, but not far enough to uncover the juncture of the opposite membranes. Special care must be directed to the upper apex where the sliding of the flaps upon each other is necessarily slight. The flaps are held in position and gently pressed together

by delicate pads and suitable packing, my preference being for the Bernays'-Simpson tampon.

Each seam now rests upon a connective tissue support and is nowhere intersected by another. Each flap has blood supply from two sources and in the general direction of arterial flow. All denuded areas are in vascular mesoblastic tissues where repair is rapid and complete. Few sutures are needed and these are so placed that their insertion is easy. Indeed, my last case seems to prove that none is necessary, and, this being true, the most tedious part of the

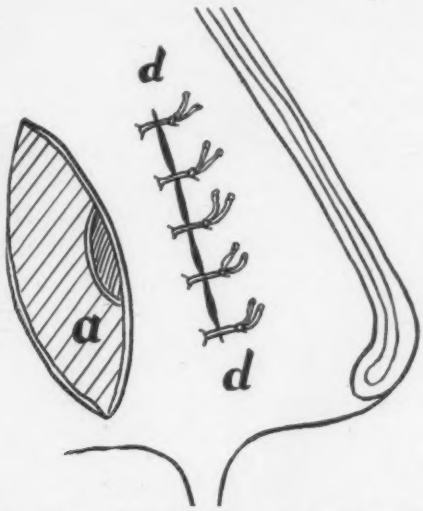


Fig. C. a, The denuded cartilage left after the plastic flap is sutured to the anterior margin of the perforation. d d, The suture. The denuded area a heals by granulation. From Dr. W. L. Ballenger's forthcoming Text Book on The Surgical and Other Diseases of the Nose, Throat and Ear.

operation is eliminated. With a little practice I believe the operation can be made as easily and quickly as the ordinary submucous resection.

Dr. W. L. Ballenger has done me the honor of describing this operation in his forthcoming text book and has kindly loaned me the three drawings made by him to accompany his description. These are herewith presented and they will aid greatly in understanding a somewhat complicated technique.

100 State Street.

THE X-RAY IN RHINOLOGY.

BY HENRY GLOVER LANGWORTHY, M. D., DUBUQUE, IOWA.

Following the introduction in America in 1895 of Professor Roentgen's discovery of the X-Ray, physicians became immediately impressed with the marvelous possibilities of such a means of diagnosis in the practice of medicine and surgery. At once skiagraphy sprang into prominence, surgeons vying with one another to perfect its use. Its application in the special fields, however, lay untouched for some years until gradually it became the routine measure of dentists in dealing with certain affections of the teeth, upper jaw and ankylosis of the inferior maxilla. Occasional cases of the localization of foreign substances within the eyeball, trachea and oesophagus were soon reported.

As early as 1902-3 the use of the X-Ray in connection with the maxillary antrum in detecting offending toothroots and the X-Raying of metal catheters placed in position in the naso-frontal duct enjoyed rather extensive use. Kassábian[1] notes that "The first skiagraph of the teeth was presented to the society of physics of Frankfort-on-the-Main, in February, 1896, by Prof. Koenig. In April of the same year Woekhoff at the Congress of Erlangen demonstrated many skiagraphs of the teeth in the living subjects." A month later Morton[2] showed that the structure of the teeth can be studied and many interesting conditions of the antrum of Highmore as well. In 1903 Dr. Wm. S. Haughton of Dublin exhibited some excellent stereoscopical radiograms of dried skulls. A little later Killian and Hajek in Germany began the use of X-Ray plates in normal and pathological conditions of the accessory sinuses.

Among our earliest American papers on this subject are those of Cryer[3] of Philadelphia and Coakley[4] of New York. Caldwell[5] of New York, an expert Roentgenologist who had been doing work with Coakley in this direction, already had a very fine collection of plates. His results were excellent, the difference between a diseased and a corresponding healthy sinus being marked. Phaler[7]

but a short time before had shown that cerebral skiagraphy was to have a place in cranial surgery and also remarked that the accessory sinuses could be photographed as well. Cryer received his impetus in this work while on a visit to Dublin, by seeing many of Haughton's plates. Coakley says that he first observed the use of the X-Ray in Killian's clinic at Freiburg. Mosher[8] of Boston, following Coakley's lead, soon published a paper in February, 1906, on The Use of the X-Ray in Sinus Diseases, in which he carefully analyzed the plates of a number of cases. Chisholm,[9] Jack,[10] Harland-Pancoast,[11] Scheier, Spiess and others contributed further to this subject.

It can no longer be lamented that "If surgeons who treat this region had some way of determining the character of these sinuses in the patient, then treatment could be given on a more scientific basis," as the practice of X-Raying our patients before operation has become well-nigh universal. It is rather rare in surgery for the surgeon to have beforehand an almost exact knowledge of the size, situation and outline of the structure and many of the difficulties to be encountered in connection with the sinus which he wishes to attack.[12]

In a high percentage of cases the presence of pus can also be diagnosed. One of the chief reasons which early prevented specialists from doing more of this work had been the difficulties of properly interpreting plates. As expressed by Williams[13] the fact that "The eye must be trained in the use of the X-Ray as is the ear for oscultation or percussion" was not appreciated and advances were at first necessarily slow. Another point to be borne in mind, as in the case of all observations on which a diagnosis is made, the conditions revealed by the X-Ray plate are only to be properly understood after experience has enabled the doctor to give these observations their due weight.

As "the best opportunity for the advantageous application of the X-Ray is obtained from the contrast of the normal tissue with that offered by pathological conditions of the corresponding region involving chiefly an increase in density," it is essential that one become familiar with the appearance of the picture in health. If a plate does not show contrast from one direction it may in another. Often plates are not taken to establish the presence of a diseased area, but simply to ascertain the anatomical outline and position of a certain cavity within the bone. Therefore we can at once group plates into two classes. The first to ascertain the anatomy of the

part as in a lateral plate; second those for the purpose of contrasting corresponding sinus areas to show pus (antero-posterior plate). The latter will also give some of the anatomy.

Roentgenologists tell us that the difference in resistance which air and various pathological fluids formed within the sinus in disease offer to the passage of the rays can readily be formulated. To these is added in this special region a background of bone lines and shadows which in turn must be discounted. If physical signs give more information than an X-Ray examination, so much the better. It would be a mistake to claim that an X-Ray plate is infallible. It is unfortunate that we have no tables which give the percentage of plate failures in the detection of pus. Roughly, I should say that plates will demonstrate pus or infaltrated mucous membrane in perhaps seventy per cent of frontal suppurations, eighty-five per cent ethmoidal and thirty-eight per cent antral. Plates in sphenoidal trouble have as yet been more or less unproductive in finding pus. In dealing with X-Ray plates, one must be sure that the best possible picture has been obtained and the plate not "fogged." Poor plates had better be discarded.

With regard to the value of skiagraphy as an aid in the diagnosis and treatment of disease of the accessory sinuses of the nose Coakley early published the following conclusions:

1. It is possible by means of a skiagraph to determine the presence or absence of a frontal sinus which extends vertically above the glabella.

2. A frontal sinus may be small, parallel with the upper inner margin of the orbit and hardly detected in the skiagraph.

3. In all cases of unilateral diseases of the frontal sinus verified by operation, a cloudiness has been observed in part or all of the area occupied by the sinus and an indistinctness in the outline of the cavity when compared with the opposite or healthy side.

4. The examination of a skiagraph of the two frontal sinuses when compared with results found on transillumination will aid very much in determining the presence of a diseased sinus.

5. A skiagraph may also be of considerable value in determining the height and width of the ethmoidal cell area and the sphenoidal sinuses.

6. If the plate be so arranged as to include the superior maxilla as well, a chronic separated process in an antrum often presents the same filmy appearance as noted in similar conditions of the frontal sinus and ethmoid cells. A healthy antrum presents an

irregular triangular area dark in color with a few light colored septa running through it, many of which are ridges present in the wall.

Although to this much has since been added, results show most conclusively that the value of the X-Ray has not been overestimated. Cryer states, "It has demonstrated by all who have investigated the pneumatic sinuses intimately that they exist in an indefinite variety of sizes, shapes and positions, so that even clinical experience counts for little as no two cases present like conditions. It is evident that a good radiogram, if stereoscopic, so much the better, is one of the most reliable witnesses for the surgeon's dependence in diagnosing the character and disease of the frontal sinus region."

Dentists draw attention to the fact that cases of odontalgia frequently reported are undoubtedly due to an unerupted tooth, in which cases the etiologic factor may be revealed by the X-Rays. Also patients suffering intense neuralgia with painful reflexes from the ear, nose and eye have shown pericemental and alveolar necrosis. Foreign bodies, defective root fillings, fracture and the position of metal splints can all be studied by intra-oral or extra-oral methods. Antero-posterior plates have helped me considerably in dealing with orbital abcess of suspected nasal origin. Plates in brain conditions give but little information as yet. Aneurysm of the internal carotid artery within the cavernous sinus, the result of basal skull fracture, has not been shown. Plates in double optic neuritis of possible sphenoidal etiology have yielded little.

Having been the first to suggest securing the size and outline of the sphenoidal bone in further simplifying an operative measure through the nose for septic thrombosis of the cavernous sinus, I have endeavored to tabulate the bone lines and shadow areas in lateral plates, but without much success. According to Carothers[16] "Stereoscopy as applied to skiagraphy is the most improved method and would seem to give the most accurate location of a foreign body, sinus, etc. The ordinary Roentgen ray plate looks flat. The stereoscope, however, gives a prospective view much as if the parts were before one."

THE LATERAL PLATE.

Two lateral plates are required, one for each side. A diagnosis of pus is not attempted from the lateral plate. This plate shows the presence or absence of the frontal sinus, its size and the extent

or position of supra-orbital cells. Any ethmoidal cell encroaching on the frontal from either below or behind will be shown. In a general way, also, the relationship between the frontal sinus and anterior ethmoid cells can be distinguished. Mosher has observed, "If the floor of one frontal sinus is higher than the floor of the other or overlapping, the line of the higher sinus will appear in the other sinus as a horizontal ridge and may be mistaken for septa." It is not safe to try to compare a right lateral with a left lateral plate, for the reason that the respective sides of the head are seldom alike. The malar bone gives a shadow obscuring a considerable number of the anterior ethmoid cells. In good plates the position of the posterior ethmoid cells can occasionally be made out. The outline of the body of the sphenoid with its cavity is prominent. Small polypi within a frontal sinus have been shown in a lateral plate. Lateral plates may occasionally also throw light on some obstinate case of headache, where the refractive error is corrected and there seemed no reason to treat the nose. It is easily seen that if the X-Ray is of importance in choosing the best external operation they are of even greater value to those surgeons who may select an intra-nasal route in an attempt to enlarge the naso-frontal duct by the use of a burr. The X-Ray plate has done much to make such a procedure safer than it has ever been before. The lateral plate may also be used in retro-pharyngeal growths and suspected abcesses. Roentgenologists are already obtaining fair pictures of oesophalgeal pouches. For the lines given by the floor of the anterior canal fossa the reader is referred to any of the articles on this subject. Lateral plates require usually more study than many are willing to give them. An excellent way to begin the interpretation of bone lines is by a good resume of anatomy, with a skull in one hand and a plate in the other.

THE ANTERO-POSTERIOR PLATE.

Often after a physical examination, to clinch the diagnosis of pus in the ethmoid cells or frontal sinus, we resort to the use of the X-Ray, taking the picture of the face. This is done with the plate in front of and against the face, the rays coming from behind. In regard to the detection of pus made from this plate, it is necessary to state that the difference between a diseased and a normal sinus is so slight that a positive diagnosis must be made very carefully. As has been said, in cases of unilateral disease of the frontals or ethmoid region a cloudiness is observed in the plate. In a normal

sinus, one gets a clear general outline of sinus wall and a relatively clearer space within. In a diseased sinus, filled with pus, the side affected is more opaque than the free side and sometimes practically obliterated. The result of this process of "matching up" is then applied to the case at hand. This plate, too, shows the size of the frontal sinus and the presence of septa and orbital prolongations. In acute inflammation of the sinus if pus has drained into the nose the infiltrated mucous membrane will give a shadow on the plate. Authors have suggested following the progress of acute inflammations and granulating sinuses by taking successive plates Infiltrated mucous membrane does not always, however, give a shadow and especially is this true in the maxillary antrum.

In conclusion it may be stated that the use of the X-Ray has done as much for the advancement of surgical rhinology as almost any hitherto single discovery in the domain of medicine or surgery. Today we are hearing much about the opsonins and especially their use in chronic suppurations. Infection, immunity and serum therapy are subjects attracting the most profound attention. It may be that a combination of X-Ray in diagnosis and opsonic serum for treatment after a proper surgical incision will stand out as one of the advances of the first quarter of the century in dealing with certain affections of the nasal sinuses.

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Temple Hall.

STRAIGHTENING THE NASAL SEPTUM.*

BY ARTHUR W. WATSON, M. D., PHILADELPHIA.

In this day of the submucous resection operation for correcting deflection of the nasal septum, the operation of straightening the septum has dropped to the background. Yet, while acknowledging that for some forms of deflection it is an admirable operation, there are those who think that the submucous operation is not without disadvantages and dangers. My own opinion is that when a deflection is corrected without resection, the patient is in a much better condition than he would have been if the framework of the septum had been removed.

Fig. 1. This Diagram accompanied the first Description of the Operation.

That such straightening can be successfully done in a majority of the cases that we meet with, is certain. All deflections which involve the lower part of the septum, generally more or less angular, both horizontal and perpendicular, including those where the end of the septum is twisted to one side; indeed, all deflections, except those of marked sigmoid character, curved deflections of the upper part of the septum and cases of considerable general thickening in narrow nasal cavities, are amenable to the straightening method.

The purpose of this paper is to call attention again to the method of straightening the septum, which I described eleven years ago before this association. I am induced to again bring forward this method, by the fact that not one of the works on diseases of the

* Read before the Twenty-ninth Annual Congress of the American Laryngological Association, Washington, D. C., May 7, 8 and 9, 1907.

nose, published since that time, has described this operation, and very few have even mentioned my name in connection with the subject, while recently several writers have claimed originality for the very methods, the overlap and the beveled incision, on which my operation was based.

I have been operating by this method for about thirteen years, and the results, in hundreds of operations, have been so good that I am still convinced that it is the best way to straighten the septum.

It is unnecessary before this association to go into the question of the causes or mode of production of deflection of the septum, or to

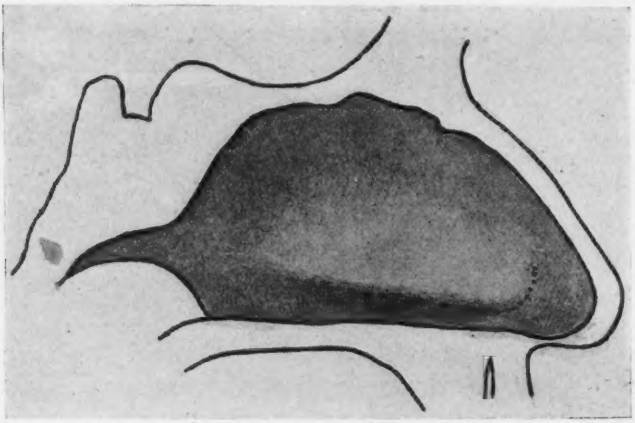


Fig. 2. Diagram showing Line of Incision in Deflection having a Horizontal Angle.

describe the different forms of deflection that we have to deal with. Suffice it to say that the chief difficulties to be overcome in any attempt to straighten a deflected septum are the redundancy of tissue and the resiliency of the cartilage. It is the want of provision to overcome these two conditions that has been the cause of failure of most of the operations devised to correct septal deflection.

In the operation which I am about to describe, by over-lapping the cut edges, the movable portion overlapping the opposite side of the fixed portion, the redundancy is done away with, and also by giving a fixed support to the cartilage in its new position, the resiliancy of the cartilage is counteracted. By making the incision through the cartilage beveled, or oblique, the amount of overlapping

is increased, thus increasing the resistance to the displacement of the cartilage.

The steps of the operation may be described as follows: An incision is made on the convex side of the septum, from behind forward, *just beneath* the angle of the deflection, following the angle to its anterior extremity and then curving upward for a short distance. (Fig. 2.) The incision is made on a bevel, or obliquely to the perpendicular. The incision is, by preference, not carried through the mucous membrane of the opposite, or concave, side. The upper part of the septum is then pushed over the lower portion into the opposite side, thus overlappping the lower portion. The same principle

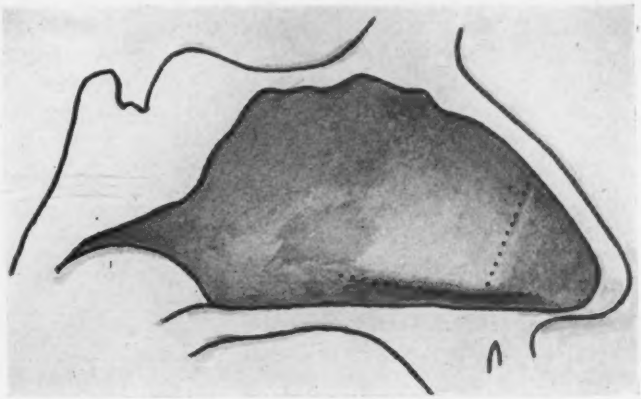


Fig. 3. Diagram showing Lines of Incision in Deflection having both a Horizontal and Perpendicular Angle.

is applied when the angle is perpendicular, the incision then being made *behind* the angle, from above downward, the bevel being made from behind forward. An incision is also made at the base, forward from the first incision, forming a triangular flap. The posterior edge of the anterior portion is then pushed over the posterior portion. If, as frequently occurs, both a horizontal and a perpendicular angle exist, both of the incisions are made, the incisions meeting at the base. (Fig. 3.) The anterior fragment is first made to overlap the posterior, and then the upper portion, including the anterior portion, is made to overlap the basal portion. This forms a

double locking and holds the anterior portion, which has no other support, firmly and permanently in a straight line.

When the deflection extends into the bony portion of the septum, a very common codition, the bony deflection is easily broken and replaced with forceps, there being no need for cutting or overlapping of the bony portion, as when broken the fragments slide on each other and thus take up the redundancy, and as the union is bony, there is no tendency to return of the deformity.

If the septum is thickened below the horizontal angle, the thickened base, which protrudes into the formerly obstructed naris should, after the parts are healed, be dealt with as if it were a spur, by saw or forceps. If the septum is thin in the lower part, and projects unduly into the naris, it may be broken into a perpendicular position, in line with the upper portion, thus increasing the overlap and making the septum more firm, the bony base soon uniting by bony union.

After the parts have been placed in line, a folded piece of gauze, iodoform, or other antiseptic gauze, long enough to extend the length of the former deflection, and about one-third to one-half inch wide, and thick enough to just pass easily into the naris, is placed in the formerly obstructed side. This dressing is renewed about every four days, until the septum is healed—about four weeks.

The instruments used are three knives and a septum forceps,—a straight knife, like a tenotome, but with somewhat longer shank; the same with blade at an obtuse angle; and one with small blade bent on the flat, almost to a right angle, and sharp on both edges. The first two are used for the horizontal incision; the last for making the perpendicular incision. The forceps are a modification of the Adams septum forceps, the fenestrum between the blades being lengthened to an inch and a quarter, in order to be able to reach the bony part of the septum, as well as the anterior portion.

126 S. 18th St.

UPPER TRACHEOSCOPY AND BRONSCOPY.*

BY CHEVALIER JACKSON, M.D., PITTSBURG.

There are a number of ways in which upper bronchoscopy and tracheoscopy may be performed, but the simplest method is as follows:

The chloroformed patient is placed in the dorsal position with the head hanging over the edge of the table, the head being supported by an assistant in the position shown in Fig. 1.

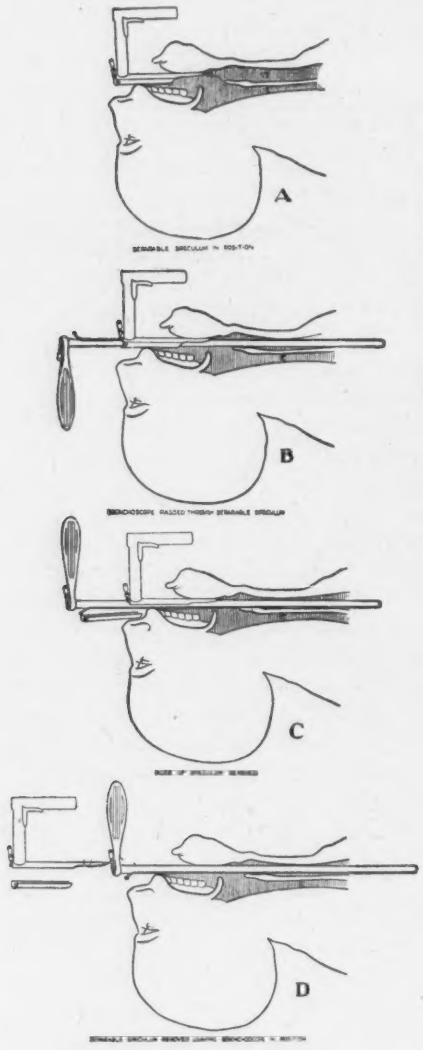
A double bronchoscopic battery is used, one cord being attached to the separable speculum and the other to the bronchoscope. The bronchoscope is held in readiness by an assistant, while the operator slides the separable speculum down over the dorsum of the tongue until the epiglottis comes into view. The epiglottis and the upper portion of the larynx may be painted over with a twenty per cent cocain solution if it is deemed necessary, which it rarely is, unless for some reason deep chloroform narcosis is contraindicated. The separable speculum is then introduced as before, and the epiglottis found. Then the epiglottis and all the tissues attached to the hyoid bone are lifted strongly with the *point* of the separable speculum. It is very necessary to lift with the point and not to use the upper teeth as a fulcrum.

When the separable speculum is in the position shown at A in Fig 2, the axis of the speculum corresponds to that of the trachea, the depths of which are seen below the vocal cords.

The bronchoscope is then introduced through the separable speculum until the tube mouth is near, but does not touch the cords. The eye is transferred to the bronchoscope and the respiratory movements of the cords are watched. When on the inspiratory excursion the bronchoscope is pushed through into the position shown in B. The gag is then inserted and the separable speculum is removed, by slipping off the slide as shown at C, leaving the bronchoscope in the trachea as shown at D.

This is by far the easiest and simplest method of introducing the tube in upper bronchoscopy. With a deeply anesthetized patient it requires in a favorable case but a minute or less to insert the

*Read before the Middle Section of the American Laryngological, Rhinological and Otological Society, Cleveland, Ohio, February 22, 1907.



SCHEMA ILLUSTRATING UPPER TRACHEO-BRONCHOSCOPY.

bronchoscope. In children it is equally easy under local anesthesia. In some cases, especially those who have not normal larynges, or in whom the neck is made rigid by adhesions following the wearing of

a tracheotomy canula, it may be difficult. In cases of bilateral abductor paralysis, the cords will not separate and it is necessary to push the bronchoscope through. In such cases it is sometimes easier to pass the bronchoscope with the obturator in place as this prevents abrasion of the mucosa or the hooking of the tube mouth over one or both arytenoids. The proceedure is the same except that the

eye is not transferred to the bronchoscope until the instrument is in the trachea and the obturator is removed. No undue haste is necessary in removing the obturator as it is so made that the air may pass freely.

The latter method with the mandrin has been found easiest by some of the men I have taught, and is used by them for all cases.

The author then exhibited with the lantern a number of endoscopic views of the trachea and bronchi.

430 Park Building.

OPHTHALMOLOGICAL MANIFESTATIONS OF LATENT DISEASES OF THE NOSE AND ITS ACCESSORY SINUSES. REPORT OF ILLUSTRATIVE CASES.*

BY FRANCIS R. PACKARD, M. D., PHILADELPHIA.

A review of the recent literature upon diseases of the accessory sinuses cannot fail to impress the reader with the increasing attention which is being paid to the ocular manifestations present in such conditions . Conversely, recent ophthalmological literature shows a correspondingly increased recognition on the part of ophthalmologists of the importance of a knowledge of the relations of sinus disease to eye trouble.

If the custom of combining the practice of otology with ophthalmology had continued there is no doubt that in view of the present important relationship between otology and rhinology the subject of the relation of intra-nasal disease to pathological conditions of the eyes would have attracted the attention it deserves at a much earlier date. Even now, although the subject is being agitated more and more, there are many oculists who seem to ignore its practical bearings in their daily work.

In the following paper, it is my desire to direct particular attention to what I consider a large and important class of cases in which latent disease of the nose and accessory sinuses manifests itself by various ophthalmological phenomena. The series of cases which I herewith present have all occurred in my practice in conjunction with Dr. Wm. Campbell Posey, of Philadelphia. Dr. Posey has already reported many of them before ophthalmological societies and in various journals.[1]

In none of the cases here reported, in which the ocular findings were of the most varied character, were the nasal symptoms marked enough to direct the patient's attention to his nose as the source of

* Read before the Twenty-ninth Annual Congress of the American Laryngological Association, Washington, D. C., May 7, 8 and 9, 1907.

1. Some Ophthalmological Phases of the Diseases of the Accessory Sinuses of the Nose. Read by invitation before the Baltimore Ophthalmological Society, March 24, 1905.

The Ocular Symptoms of Affections of the Accessory Sinuses of the Nose. Read in the Section on Ophthalmology of the American Medical Association, at the Fifty-sixth Annual Session, July, 1905.

The Accessory Sinuses of the Nose from an Ophthalmological Standpoint. Read by Invitation before a Conjoined Meeting of the Maryland Ophthalmological and Rhinological and Laryngological Societies, February, 1907.

his trouble. Of course, every ophthalmologist and rhinologist is familiar with the cases of orbital cellulitis due to infection from the ethmoidal cells and the mechanical effects of the presence of pus in the frontal and ethmoidal sinuses or the antrum are also sufficiently familiar.

I believe, however, that there should be more active co-relation between the ophthalmologist and the rhinologist in order to insure the recognition of the class of latent cases of nasal trouble such as are herewith presented.

Posey classifies the ocular symptoms which may occur as the result of intra-nasal sinus disease under thirteen heads, as follows:

Disturbances in Vision and the Visual Field.
Changes in the Orbit.
Affections of the Lachrymal Apparatus.
Affections of the Lids.
Affections of the Extraocular Muscles.
Affections of the Conjunctiva.
Affections of the Cornea.
Pupillary Changes.
Affections of the Uveal Tract.
Cataracts.
Reflections.
Asthenopia.
Headaches and Neuralgia.

As will be seen, the range of such pathological conditions is a large and important one, but to the mind of the rhinologist the chief importance of the groups of cases which I report, lies in the fact that the ocular symptoms were in each instance the result of a hitherto unsuspected nasal pathological condition.

Case 1. G. L. M., age 29 years, consulted Dr. Posey in September, 1902, because of pain over the left eye, which was worse in the morning, but passed away as the day wore on. The pain over the eye was very severe, and as it radiated into the back part of the eye, it had led his physician to send the patient to see Dr. Posey. Dr. Posey found that there were no opthalmoscopic changes in either eye, and vision and the balance of the extraocular muscles were normal.

Dr. Posey referred him to me, and upon examination I found a marked chronic hypertrophic rhinitis, with great obstruction to the outlets of the sinuses. After contracting the tissues with cocaine and adrenalin, I was able to get away a great deal of discharge from his ethmoidal and sphenoidal cells. Several repetitions of this treatment were followed by a rapid subsidence of pain and no further ocular phenomena manifested themselves.

CASE 2. Miss A. B. was seen by Dr. Posey on the 14th of September, 1904. His report of her condition at that time was as follows:

"Miss A. B. consulted me early in the autumn, complaining of pain over the left eye, which was made worse by stooping over. The eye was described as feeling prominent and as being stiff in its socket. The opthalmoscope revealed that the edges of the left optic nerve were everywhere hazy and that the blood vessels, especially the veins, were fuller and more tortuous than normal. Vision in the left eye equalled 5/6, that in the right 5/5. The difference in the vision in the eye was, however, much accentuated by the use of the Bjerrum types, the vision of the left eye being particularly affected, indicating a marked diminution in the light sense of that eye."

Dr. Posey referred her to me, as she stated she had a cold in her head for several weeks previous, and there had been a slight discharge from her nose. I wrote him the following report upon her condition at that time:

"There is considerable muco-pus discharging from the left ethmoidal and sphenoidal regions which pours over the surface of the swollen left middle turbinate and into the nasopharynx. I have seldom seen much more marked unilateral congestion in these regions than is present in this case. On the right side, although there is a condition of chronic catarrhal rhinitis, there is comparatively little swelling of the tissues, and no acute congestion in the ethmoidal and sphenoidal region. The frontal sinus and antrum are apparently not at all involved in the process."

As her trouble seemed to be entirely dependent upon her nasal condition, Dr. Posey relinquished her treatment to me The intranasal condition soon subsided under local cleansing and the application of a mild solution of iodine and potassium iodide. She still has a slight diminution in the light sense in the left eye.

CASE 3. H. L. S., a young man, consulted Dr. Posey on February 23, 1903. He had a herpetic keratitis of a dendriform type in his right eye, consecutive to an attack of grip. At that time he suffered from an acute ethmoiditis. In February, 1905, two years later, followed another attack of grip, the right eye became reinflamed, showing a corneal inflammation similar to that which had occurred two years previously. Dr. Posey referred him to me for examination. I found an acute purulent ethmoiditis in association with the ocular and nasal inflammation, there was a herpetic eruption over the infra-orbital branches of the 5th nerve of the affected side. After the removal of the right middle turbinate his intranasal and ocular symptoms were completely relieved.

CASE 4. B. H. B., a young man twenty-two years old, consulted Dr. Posey in February, 1905. He stated that for three months he suffered from a heavy feeling in his head and attacks of dizziness

and dull strained pain in the eyes, and occasional diplopia. Dr. Posey's examination was as follows:

"Ophthalmoscopic examination was negative; corrected vision was normal in both eyes. The upper lid of the left eye was edematous. There was a left hyperphoria of 1° and an exophoria of 2° at the far point, and of 8° at the near. Examination revealed a paresis of the left superior rectus muscle."

Upon examination of the nose I found a chronic catarrhal rhinitis with great hypertrophy of both middle turbinates. Although at that time there was no pus in any of the sinuses, the cystic condition of both middle turbinates and his history of frequent attacks of pain in his cheeks and forehead led me to suspect that he had probably suffered in the past from attacks of suppurative sinusitis. I removed the hypertrophied turbinates with the cold snare and bone forceps. Since that time he has had no further trouble.

CASE 5. Miss E. C. M. consulted Dr. Posey in September, 1906. She stated that she had been subjected to dull pain in the left eye since the preceding spring, and had also some distress in the right eye. He reported:

"Examination revealed a distinct left optic neuritis, the retinal vessels being full and tortuous and the nerve edges somewhat obscured, with an associate choking of the lymphatics on the head of the nerve. The retinal veins in the right eye were fuller than normal; vision in the right eye was normal; that in the left 5/6, the difference being more marked when the Bjerrum type was employed."

Dr. Posey referred Miss M. to me and I reported to him as follows:

"Miss M. has a very similar condition to Miss. B. (CASE 2), except that it is more chronic. There is a hypertrophy of both middle turbinates especially marked on the left side. The left bulla ethmoidalis is much swollen. Transillumination of the sinuses revealed no indication of pus."

The condition is purely "catarrhal." In this case cauterization of the hypertrophied turbinates with chromic acid relieved her catarrhal symptoms and she has had no return of the eye pain.

CASE 6. Mr. T. D. W., age 20 years, referred to me by Dr. Posey on January 12, 1907. He had suffered from frontal headaches for eighteen months, which had been somewhat relieved by glasses prescribed by Dr. Posey about one year ago. He said that he was quite unconscious of ever having had any trouble with his nose. Dr. Posey sent him to me because, upon examination, he had found an optic neuritis upon the right side. Upon examination, I found that the patient had marked hypertrophy of the right middle turbinate, the swollen tissues impinging upon a septal deflection to the right. The swollen turbinate was not cystic, but an ordinary hypertrophied membrane. I shrunk the hypertrophied tissue with several

applications of chromic acid. It was not feasible to operate upon the septal deflection as the patient was upon the point of leaving the city.

I received the following report from Dr. Posey on March 18th:

"T. D. W. is an interesting case of ocular changes from sinusitis. The treatment which you gave him in January relieved his head pain entirely. Opthalmoscopic examination still shows, however, a low grade neuritis upon the right side, the nasal edges of the nerve being blurred and the central lymphatics full. Mr. W. has also quite a pronounced muscular error, the eye looking on a different vertical level and showing a slight tendency towards divergence. As the degree of the vertical insufficiency varies, I think it very probable that it is dependent in a great measure upno a hyperaemia of the orbital tissues."

CASE 7. "Mr. N. B. W., age 32 years, referred to me by Dr. Posey January 10, 1907, with the accompanying report: The patient has an intense degree of hyperaemia and oedema of both optic nerves, more marked, however, upon the left side. The edges of the nerve are blurred, the retinal veins full and somewhat tortuous and the lymph passages along the walls of the retinal vessels are choked and distended. There is no intraocular cause for this appearance in the optic nerves, the retina and choroid being free from inflammation. The vision in both eyes is normal, and there is no restriction in the visual field, either for form or color. The appearance of the nerves can, I think, be explained wholly by an interference in their circulation, due to pressure at the back of the eye, such as might be evoked by a sinusitis of either the posterior ethmoidal or sphenoidal cells."

On examination I found that Mr. W. had a cystic condition of both middle turbinates. On each side they were in close contact with the septum. He told me that he had not been conscious of any nasal trouble for some years, but that when seven years old he had had a shoe button removed from his left nostril, which he had placed there some three or four years previously.

For several years subsequently to its removal he had suffered from constant catarrhal manifestations, as stated above. These had for some years entirely disappeared. The patient was also very deaf in the left ear, the hearing being diminished about 1/24 normal for the watch. Hearing by bone conduction was much better in the left ear than in the right. The left membrana tympani was thickened and retracted.

He told me that for upwards of a year he had suffered very considerably from frontal headaches. In a number of subsequent sittings I removed the cystic middle turbinates with forceps and cold wire snare. At the end of three weeks the patient left the city. By that time he was quite free from headaches, and declared that his

nose felt so comfortable and clear that he must have been very uncomfortable before, although he was quite unconscious of it at the time.

CASE 8. Mrs. F. was referred to me by her family physician, Dr. Edward B. Hodge, on December 28, 1906. She had been a patient of Dr. Posey, who kindly furnished me with the following report of her case:

"Mrs. F. first consulted me April 10, 1906, being referred to me by her family physician, Dr. Edward B. Hodge, on account of supra-orbital headaches. Both eyes presented but a moderate amount of far-sighted astigmatism and the extraocular muscle balance was practically normal. She was given the proper correcting glasses, and her head symptoms were much relieved. On December 28, 1906, she returned, complaining of frontal pain. Examination revealed swelling and tortuosity of the retinal vessels, especially the veins. There was also a spasm of the ciliary muscles in both eyes. When account was taken of this latter factor, vision, however, was rendered normal and there was no restriction in the fields for either form or color."

This patient had a marked acute frontal sinusitis worse upon the left side, both of the middle turbinates were hypertrophic and cystic. After their ablation with the snare and forceps, her frontal sinusitis cleared up and she has had no return of her headaches.

CASE 9. Mr. W. P., referred to me by Dr. Posey in December, 1906, suffered from frontal headaches and pain in the eyes. Dr. Posey reported the case to me as follows:

"The ocular symptoms in Mr. W. P.'s case consisted in enlargement of the follicles in the retro-tarsal folds of the conjunctiva of each eye, together with an overfulness of the retinal veins. There was also more muscular asthenopia than could be accounted for by his refraction and muscular error, leading me to seek for other causes to explain his symptoms."

In this case there was a very marked ethmoiditis which subsided under a bland spray and the application of adrenalin and eucaine to the swollen tissues. After the acute condition had subsided I cauterized the hypertrophied middle turbinates which caused rapid disappearance of the symptoms.

There have been several recent American contributions to this subject. Among them I would direct particular attention to the paper of Dr. Hill Hastings.[2] In it Dr. Hastings reports several cases very similar in their details to those reported by me. T. H.

2. *Ann. of Otol., Rhin. and Laryngol.*, Sept. 1906

3. Trans. Am. Laryn., Rhinol. and Otol. Assn., 1901.

Halsted[3] reports an interesting case of sudden blindness due to damming up of pus in the sphenoid sinuses. At the same meeting Hoople[4] presented a paper in which he stated that pressure upon the middle turbinate, whether from hypertrophy of the middle turbinate, or from a septal spur or deflection, is a very frequent cause of trouble with the ocular muscles.

Dr. C. R. Holmes[5] last year published a long and exhaustive article on the ophthalmological complications of intra-nasal disease, in which he reports many interesting cases bearing upon this aspect of the subject.

1836 Pine.

4. Trans. Am. Laryn., Rhinol. and Otol. Assn., 1901.
5. *Ohio State Med. Journ.*, Feb. 1906.

The Management of Deaf-Mutes. MARCZEL FALTA. *Archiv f. Ohrenh.*, Leipzig, Dec. 1904.

Infants begin to react to sound impressions at about the fourth week; but, in a case of the author's the child was apparently deaf until the ninth month. The use of rattles and other noise-producing toys may develop the hearing power.

Systematic instruction of deaf-mutes should begin at the age of 8 years. Careful physical examination should be made, especially of the eyes, as so much of their instruction depends on their vision. Gymnastic exercises are of the greatest importance. They develop the lungs, maintain the general health, and develop the static sense, which is often deficient in deaf-mutes. The power of recognizing the strength and even the direction of vibrations can be developed to a high degree, and serves the useful purpose of warning the deaf-mute of the approach of vehicles, etc. YANKAUER.

A CASE OF SARCOMA OF THE MAXILLARY SINUS.*

BY F. T. ROGERS, M. D., PROVIDENCE, R. I.

I desire to present this case to the section for two reasons; first, to recite briefly the remedial measures which have been followed in a peculiarly distressing case and to show the condition of the growth after seven months of active treatment and to afford an opportunity to examine a case which is not unusually rare but presents some peculiar features, and second, to gain from the discussion that may follow the ideas of the members as to the advisability of further procedure.

This patient has been under my observation for a matter of fifteen years. Specific disease in early life destroyed the septum but for a number of years there has been no recurrence of the disease. In May last he came to me with a swelling in the left maxillary region. Anticipating an empyema of the sinus, a perforation was made through the nose but nothing was obtained and later an opening was made into the antrum through the canine fossa and the present condition was found. At that time the cavity was thoroughly curetted. The growth apparently sprang from the anterior lateral wall of the sinus and was crowded over so as to completely destroy the integrity of the nose. The sinuses of the nose were exposed both to the finger and to the mirror. The inferior orbital wall had been perforated by the pressure of the growth and a considerable quantity protruded into the orbital cavity. This was also removed with the curette as completely as possible. There was no recurrence until some time in July when it rapidly began to grow worse, and early in the summer, by my advice, he consulted Dr. Coakley who gave as his opinion, that the complete abolition of the left side of the face was the only opportunity which presented itself for relief of the trouble but that he did not advise it. Later it was decided to attempt the removal of the superior maxillary bone and the operation was started with that intent. The extensive destruction of tissue, however, which was encountered, and the probable loss of the integrity of the eye and the hideous deformity which would have resulted, caused us to hesitate and after the bone had been exposed by the ordinary incision it was decided to clean the cavity as well as possible and allow the case to progress without

*Read before the Eastern Section of the American Laryngological, Rhinological and Otological Society, Providence, R. I., January 5, 1907.

further surgical interference. The wound healed kindly with the exception of the cicatricial attachments which formed under the edge of the orbit but about the second or third week it took on an exceedingly offensive odor and the growth has gone on with intervals of apparent quiescence. There is no pain and there has been very little disturbance of the general health and the condition which shows today is such that I would like you all to see. The treatment which has been followed comprises all the methods which are known to me by personal experience and from my study of the literature on the subject. He has been taking methylene blue combined with quinine and belladonna for several months. This idea was taken from Dr. Jacobi's monograph on the value of the fluorescent salts in sarcoma. The X-ray was tried with no other effect than to destroy the unpleasant odor. The Finsen ray was experimentally used with the effect of producing an erythema of the skin and undoubtedly aiding in the formation of a local abscess which followed the injection of trypsin. He has had trypsin injections up to the limit of the ampoule which contains 20 minims beginning with the smaller doses, injected into the arms, shoulder and buttocks, and small quantities were injected deeply into the growth and into the skin about the growth. One unfortunate injection in the face caused a needle abscess which gave rise to considerable pain for some days but which is the only pain he has suffered. Lately I have used the clear injectio-trypsini without diluting it, injecting it into the opening which is left in the cheek. I think, without exception, that this procedure has shown the most marked effect of any remedy which I have used. For the last month or six weeks the growth has not increased and the odor has disappeared, and it seems to me that it is in a measure smaller than it was early in December. Several times, when the growth has encroached upon the mouth it has been necessary to cut it away in order to prevent interference with swallowing and with the mastication of food, and each time that the growth has been mutilated in any way there has been an increase in the formation, very marked within the week or ten days following.

As I said before, it is not an unusual case, yet it is not so common that we can afford to neglect it and I shall be very glad to show the patient to those who are interested and later to learn your opinion as to what should further be done in the case.

117 Broad St.

A BRIEF NOTE ON THE INDICATION FOR RADICAL OPERATION ON THE NASAL ACCESSORY SINUSES.*

BY NORVAL H. PIERCE, M. D., CHICAGO.

The following paper has been inspired by a case of pansunuitis which terminated fatally after operation by a fellow practitioner and by the growing tendency on the part of some operators to too hastily deal radically with cases which in the opinion of the writer might be better treated by more conservative methods.

The remarks which follow must of necessity be general in character, as the time allowed for the reading of the papers of this program must be brief.

First, let us consider the question as to the damage to life of suppuration within the accessory sinuses without operation. Pit in his well known report of 9,000 autopsies held at Guys' Hospital reports but 1 case of death attributable to nasal suppuration. Zarinko, quoting Treitel, gives 1 extra dural abscess and 2 cerebral abscesses as of rhinal origin out of 6,000 autopsies at the Berlin Pathological Institute.

Wertheim out of 10,396 autopsies held at the Pathological Institute of Breslau gives only 6 as of rhinologic origin.

Dreyfus, in his Monograph published in 1896 collected fifty-eight cases of cerebral complications from literature of which 5 were referable to the maxillary sinus, 22 to the frontal sinus, 18 to the ethmoid cells, and 13 to the spenoid. That is 40 of the 58 involved the fronto-ethmoid cells—the group which is by far the most frequently the starting point of grave complications.

Givens in 1900 collected 142 cerebral abscesses of which only 6 were of nasal origin.

From a consideration of the literature, therefore, we are justified in the conclusion that there is but very slight danger of encepholic complications arising in the course of either an acute or chronic sanuitis.

In contrast to this showing of cases not operated on is the rapidly swelling list of deaths following operative intervention. This phase of the subject has been recently developed in an excellent article by Dr. A. Carpait.

*Read before the Middle Section of the American Laryngological, Rhinological and Otological Society, Cleveland, Ohio, February 22, 1907.

In 1904 Lermoyez, at the French Laryngological Society, remarked that the frontal sinus is rarely a source of danger to life so long as it is not operated on. Luc admitted that a sixth of his cases operated on by the Ogston-Luc method suffered from intracranial complications. He has therefore discarded this type of operation in favor of the Killian method. Killian's statistics give much happier results, but Copart knows of two fatalities following operation by the Killian method, and Thiel reports 1 death in 6 operations.

I will not detain you with exhaustive details of reported cases, but will simply boil the matter down to the statement that experience teaches us at the present time that the mortality of accessory sinus suppuration has been greatly increased by operation interference. The reason for this is imperfect technique, improper selection of cases, and increasing frequency of operating, since the introduction of external methods.

Naturally a clinical parallel has been drawn by the medical mind between the mastoid cells and the nasal accessory sinuses. We are now in a position to realize that this has led to erroneous conclusions. Suppuration within the mastoid is always fraught with danger on account of the immediate proximity of the sigmoid sinus, and the liability of the suppurative process to break down the membranous guards of the two fenestral with subsequent involvement of the labyrinth and extension to the cerebral contents, while thrombophlebitis and general sepsis from accessory sinus disease can occur only by extension of suppuration through intervening tissue to more or less remote venous channels. In operations on the mastoid the field is completely accessible to sight and touch. The same can scarcely be said to be always the case with the accessory sinuses. Lastly operations on the mastoid are not followed by that peculiar form of osteo-myelitis which is apt to follow operation on the accessory sinuses, especially of the fronto-ethmoid group, and which depends probably on a thrombo-phlebitis of the diploetic veins.

As with the mastoid so with the accessory nasal sinuses we may operate either to prevent dangerous complications to bring suppuration to a close, to relieve disagreeable or unbearable symptoms or to save life after the dangerous complications have arisen. But we must remember always that operations on the accessory sinuses are fraught with peculiar danger—dangers not met with in mastoid work. He will arrive at the best results who will most prudently weigh the dangers of operation as against the dangers to which

the diseased sinuses expose the patient, or as against the relief of symptoms more or less annoying, unpleasant or unbearable.

In a broad way, therefore, I believe it to be a mistake to immediately resort to radical external operations merely because the Skiagraph or intra-nasal examination discloses pus in the antrum, fronto-ethmoidal or spenoid cells. Satisfactory results may usually be obtained by local intra-nasal procedures. Especially is this true of acute cases; and in chronic cases the external operation should be restricted to those cases which have resisted intra-nasal procedures and in which acute exacerbations show a progressive disease, or in assuming the dangers inseparably connected with radical operations on the sinuses.

31 Washington St.

New View on the Question of Adenoid Vegetation. M. V. LANGE, de Copenhague. *Rev. Heb. de Laryng., D'Otol. et de Rhinol.*, Feb. 23, 1907.

The author claims that the reason that we have cases of unsuccessful results after the operation for adenoid vegetations is due to the fact that these are frequently associated with hypertrophy in the naso-pharynx which persist even though somewhat ameliorated by the operation.

It is therefore important to follow the treatment of Meyer: A few days after the removal of the vegetations by the proper instruments we should commence the second part of the treatment, which consists of energetic application of fused silver nitrate by means of an applicator, following by free irrigation of warm salt water. In this way the vegetations remaining after the operation are destroyed and thus corrects the hypertrophic catarrh.

If the treatment of Meyer appears too energetic, the usual method is insufficient as it neglects the catarrh of the cavum which is often neglected while the operation is perhaps too frequent.

The author does not believe that adenoid vegetations have any influence in the majority of cases of nocturnal incontinence of urine, and believes that in such cases the treatment should be directed to the nervous system. SCHEPPEGRELL.

AN UNUSUAL CYST OF THE LARYNX.*

BY D. CROSBY GREENE, JR., M. D., BOSTON.

Cysts of the larynx are benign tumors which, when situated on the epiglottis, are ordinarily inoffensive and may attain considerable size without producing serious disturbance. The following case which came under my observation at the Boston Children's Hospital last summer was unusual in point of size and in the resulting obstruction to breathing and swallowing which became a serious menace to the health and even the life of the patient:

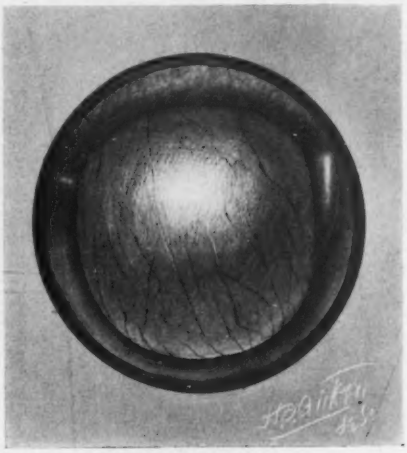
ANNIE C. ———, nine years of age, was admitted to the hospital on July 27, 1906, on account of dyspnoea. The parents gave this history. The child was born prematurely at seven and a half months, but was healthy up to the age of two months. At that time she began to have a cough which had persisted fairly constantly ever since. She had never breathed quietly. For three weeks previous to her admission to the hospital her breathing had been becoming gradually more and more difficult. She had taken very little food and was rapidly losing flesh and strength. When she lay down the difficulty in breathing was increased. She slept poorly and sat up in bed most of the night.

PHYSICAL EXAMINATION. The child was small for her age, pale, emaciated and drowsy. Her breathing was open-mouthed, labored and accompanied by a loud, low-pitched, inspiratory sound, dilatation of the alae nasi and supra and infra-sternal retraction. On examination of the chest a small area of dullness was found at the base of the left lung below the angle of the scapula over which the breathing sounded harsh. External physical examination was otherwise negative.

The nose and upper pharynx presented nothing abnormal. Laryngoscopic examination disclosed a smooth bluish red, globular tumor a little over an inch in diameter involving the right half of epiglottis and the right pharyngo-epiglottic fold, in contact with the base of the tongue in front and with the posterior wall of the pharynx behind. It pushed the epiglottis well over to the left and completely concealed the cavity of the larynx. It was firm and tense to the touch and not apparently fluctuant.

*Read before the Eastern Section of the American Laryngological, Rhinological and Otological Society, Providence, R. I., January 5, 1907.

In view of the marked dyspnoea and the extremely weakened condition of the child it seemed to me advisable to perform tracheotomy before attempting to remove the tumor. Accordingly, on July 28, I did a rapid tracheotomy under light ether anaesthesia, preceded by atropine gr. 1-300 given under the skin. The child made a quick recovery from the operation and immediately began to improve not only in the ease of respiration, but in general condition. She slept comfortably for the first time in weeks, and for the first twenty-four hours after operation slept most of the time. She was still unable to take solid food but took a good quantity

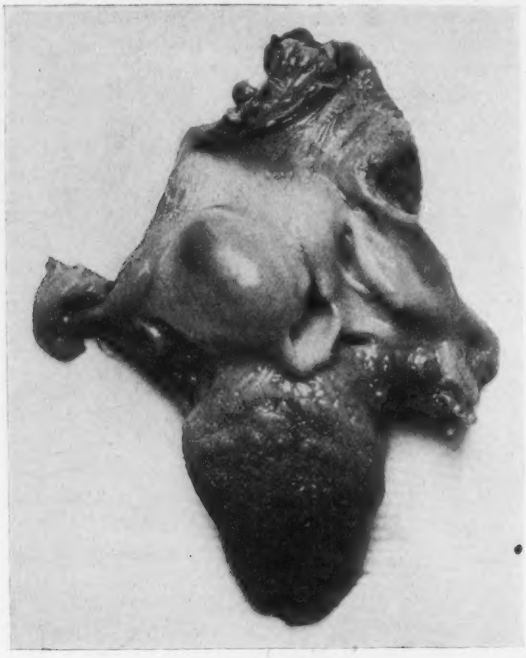


Cyst of epiglottis. Drawing of laryngoscopic image enlarged. Author's case.

of liquid nourishment. Two days after the tracheotomy a change in the appearance of the tumor was noticeable: It appeared a little larger and the surface color had changed from a dusky bluish red to a yellowish hue. Against this back ground the small red ramifying surface blood vessels could be easily seen. The accompanying drawing was made for me at this time by Mr. Aitken. On August 7th, eleven days after the tracheotomy, the child having gained much in strength, I attempted to remove the tumor by means of a snare. The child was etherized in Rowe's position through the tracheotomy tube and the cyst seized with tenaculum forceps and drawn into the loop of the snare. At this point the forceps tore out, rupturing the wall of the cyst and emptying the contents, a brown fluid, into the mouth. With the collapse of the cyst the parts assumed relatively their normal position, the epiglot-

tis reverting to the median line, and I discontinued the operation. The tracheotomy tube was removed on the following day.

During the succeeding days the tumor began to develop again, and in a week was about one-half its former size, but gave no obstruction to breathing or swallowing. On August 17th, the child was again etherized and I removed a portion of the cyst wall with biting forceps. This resulted in the evacuation of about a teaspoonful of pus. The cyst had evidently become infected at the first operation with some mild pyogenic organism which did not produce any systemic disturbance, for the child had no fever and gained steadily in general condition while the cyst was refilling.



Cyst of epiglottis in two weeks' old infant. Natural size. Case of Dr. Mix.

Microscopic examination of the cyst wall, by Dr. H. C. Low, showed a wall of granulation tissue infiltrated by lymphocytes and polymorphonuclear leucocytes with squamous epithelium on both surfaces, i. e., a subacute inflammatory process in the wall of the retention cyst. There was no evidence of tuberculosis or indication of embryonic tissue cells. There has been no recurrence of

the tumor since the last operation. A certain amount of inflammatory swelling remained at its site for a time, but gradually diminished. Laryngoscopic examination showed only slight thickening of the right pharyngo-epiglottic fold. The child is in excellent health.

Through the courtesy of Dr. C. M. Mix of Muncie, Indiana, I am enabled to add the report of another grave case of cyst of the epiglottis which came under his observation. Dr. Mix is preparing a detailed report of this case for publication.

The patient was a newborn infant who had marked inspiratory dyspnoea from its birth. The difficulty in respiration increased up to the end of the second week, when the child died from the obstruction. At autopsy the condition was found to be as shown in the excellent photograph taken by Dr. Mix. This is the third reported case of cyst of the epiglottis in the newborn causing death which I have been able to find. It is possible, as Dr. Mix suggests, that these tumors are of more frequent occurrence in the newborn than has been supposed, and that if the profession were on the lookout for them more cases would be found.

Since 1863, when Gibb[1] first observed and operated on a cyst of the right vocal cord, a large number of cysts of the larynx have been recorded. Beschorner[2] in 1877, in an article reporting a case of cyst of the epiglottis, stated that in a series of 693 cases of tumors of the larynx which he had collected, 45 or about 6 per cent were cysts.

The distribution of cysts of the larynx was found by Moure[3] in 117 cases to be as follows:

Epiglottis	50
Vocal cords	45
Ventricles	8
Arytenoids	4
Ary-epiglottic fold	3
Cartilage of santorini	1
Ventricular bands	2
Site not given	4
	117

Purseigle[4], in a review of all reported cases of tumors of the epiglottis up to 1905, found that 40 per cent were cysts. These cysts are generally of small size, the great majority being not larger than a small pea. A few as large as a hazel nut have been reported.

Hamilton, of Montreal, operated on a cyst of the epiglottis as large as a small hen's egg, in a youth of sixteen years, which is, I believe, the largest on record.

Cysts have caused death from asphyxia. Edis[7] and de Cheveney[8] have each reported a case of congenital cyst of the epiglottis in the new born which caused dyspnoea, cyanosis and death in twelve hours. On the other hand, cysts of small size do not give rise to serious symptoms and may be carried for years without special discomfort. They may be spontaneously evacuated without leaving any trace of themselves as in three cases reported by Beshorner[9].

In structure and origin there are three varieties:

(1) By far the most common is that due to obstruction at the mouth of a mucous gland with retention and accumulation of the secretion of the gland.

(2) A second variety has been found on the vocal cords due to accumulation of lymph either in the lymph vessel or in the lymph spaces of a polypoid growth on the cords.[10]

(3) The third variety includes those which are derived from embryonic tissue cells.[11]

TREATMENT. Cysts have been cured by simple puncture or incision, but, as this method is likely to be followed by recurrence, a preferable method is removal either by means of a snare or by avulsion with forceps. Preliminary tracheotomy is only indicated with extreme dyspnoea.

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483 Beacon St.

CALCULI IN THE SALIVARY DUCTS; REPORT OF A CASE.*

BY JOSEPH S. GIBB, M. D., PHILADELPHIA.

Obstruction of a salivary duct is a condition not infrequently observed by the surgeon, a very familiar example of which is that condition called ranula. Any one of the ducts, the parotid, submaxillary or the sublingual, may be the site of the obstruction. Swelling at or near the mouth of a duct, caused by an inflammatory process, or an inspissation of the secretion, or the entrance of a foreign body into the mouth of the duct, are the usual causes of the obstruction.

The result of the obstruction is a retention of the normal secretion more or less complete, depending on the character of the obstruction, and a consequent swelling between the point of obstruction and the salivary gland. As for example, in ranula we observe a bluish-white-transparent swelling close to and at one side of the frenum linguæ, this being due to retention of the secretion of either the sublingual or submaxillary glands, or both, by some obstruction to its flow at the outlet of the duct of these glands. These, then, are the usual obstructive lesions observed in the salivary glands and their ducts. Much more rarely is seen the obstruction of a duct by the inspissation of the secretion and the deposition of salts, the normal constituents of the salivary secretion, constituting a salivary calculus.

Both of these varieties of salivary obstruction may exist for a long time without producing symptoms, and it may not be until the cyst in the one case and the calculus with the retained salivary secretion in the other becomes so large as to interfere with other functions in the mouth, that the abnormality is recognized. In some cases, however, and especially may this be so in the calculi cases, symptoms of much annoyance persist for a considerable time before the true nature of their causation is recognized.

Among the annoying symptoms may be mentioned periodic swelling in the region of the gland whose duct is the seat of the obstruction. As, for example, around the ear in case of obstruction of Steno's duct; on the floor of the mouth close to the ramus of the jaw in the case of obstruction to Wharton's duct; and on the

* Read at Meeting of the Section on Otology and Laryngology of the College of Physicians of Philadelphia, March 21, 1907.

floor of the mouth close to the frenum linguæ where the sublingual duct is obstructed. These periodic swellings are sometimes accompanied by severe pain. More frequently the sensation described is that of an unpleasant fullness, giving rise to much discomfort.

The obvious explanation for these periodic swellings and abatements is complete retention, followed by relaxation of the duct and release of the secretion. In some cases this explanation is made the more convincing by the statement of the patient, that at the time of the diminution of the swelling there is always a coincident outpouring of saliva into the mouth, as was stated by the patient whose case is reported tonight.

While the symptoms caused by the obstruction to a salivary duct is usually as stated, more of discomfort than pain, there are records of cases in which serious and urgent symptoms have accompanied it. Myles[1] reports the case of "a very stout man, with a short, thick neck, in whom there was serious interference with respiration. The epiglottis was swollen and pressed up by a large teat-like swelling on the lowermost part of the base of the tongue. A small fistula was to be seen in the floor of the mouth near the last molar tooth. The oedematous epiglottis was incised in several places with a protected laryngeal bistoury, and the swelling rapidly subsided to about half its former size. The projection at the base of the tongue was seized with a lingual tonsillotome and its apex cut away. It contained a burrowing cystic abscess filled with salivary and muco-purulent secretion. All the alarming symptoms rapidly subsided." Later, by bi-manual palpation and probing, he was able to detect a calculus in the submaxillary gland. This latter was removed in small pieces by dilating the duct and curetting. The symptoms were entirely relieved and the patient recovered.

The etiology of salivary calculi is obscure; there are probably several causes. Alteration of the secretion in the gland, causing inspissation, is a factor. This may arise from inflammatory or other initiative processes. Diminution of the normal calibre of the duct of a salivary gland from an inflammatory process, thereby retarding the natural flow and causing inspissation of the secretion and deposition of salts. The entrance of a foreign body into the duct, serving as the nucleus for the deposition of the normal salts of the salivary secretion, has been dwelt upon by some observers. The

[1]Myles. THE LARYNGOSCOPE, December, 1904, p. 916.

more modern views as to the causation of diseased processes, namely, by the intervention of bacteria, prevail here, and are the most commonly accepted by recent investigators.

An infectious process is inaugurated at some point in the gland or along the duct, which is invaded with myriads of bacteria; a collection of these bacteria form the nucleus of the stone. This condition has been verified by numerous observers. The bacteria found have been those which are usually found in the mouth under normal conditions.

The composition of a salivary calculus is both organic and inorganic. The nucleus is apt to be a cluster of bacteria or a foreign body surrounded by myriads of bacteria; superimposed upon this mass is layer upon layer of the usual salts found in saliva—mostly phosphate of lime. Calculi are of varying sizes and shapes; those in the glands are usually larger and more numerous than those in the ducts. Glandular calculi are also more irregular in their contour. Calculi in the ducts are more or less round in shape and vary in size from a millet seed to a grain of corn, or even larger.

The diagnosis of calculi is attended with some difficulty, since the cases are often obscure in the early part of their course. Unilateral swelling, often of an intermittent character, in the neighborhood of a salivary gland, should excite the suspicion that such an abnormality existed. This suspicion should lead to a careful examination along the course of the duct whose gland is the seat of swelling. If there is not too great oedema around the duct so that the calculi is imbedded, its presence will be detected by this means of examination.

The obvious treatment of calculi of the salivary duct is complete removal of the obstruction from the duct with as little injury as possible to the caliber of the duct and the surrounding mucous membrane, and an endeavor to effect a normal condition of the duct. Whenever possible the removal of the stone must be through the mouth. To accomplish this purpose, the calculus is grasped between the thumb and finger of one hand and the mucous membrane made tense over its surface. This incision is then carried down to the stone and the latter made to engage in it, from whence it is carefully extracted. Likely adhesions have formed around the stone and it is not so easily extracted as this description would seem to indicate. Care in dissection, however, will enable us in most cases to extract with little trouble. If very large, the stone may be crushed by a hemostat or other strong forcep and extracted piecemeal.

An effort should be made to find the duct and determine whether or not a stricture or any other condition diminishing its caliber exists. Should the duct be found abnormally contracted dilatation by means of graduated bougies may be employed. The wound made by the incision generally heals quickly.

Salivary fistulæ are a very unusual complication, but the possibility of such an accident should be borne in mind, because in some localities, e. g., in Steno's duct, it would be an unfortunate and disagreeable complication.

These desultory remarks have been suggested by the case, whose history is as follows:

J. W., aet. 27, came to see me because of a sore throat and an uncomfortable sensation below the angle of the jaw on the left side.

He stated that for a long time, perhaps a year or more, he has had discomfort at the angle of the jaw, accompanied by swelling below the angle and on the inner side of the jaw and floor of the mouth. This has not been continuous, but seemed to come on in attacks which would last for a time and then almost suddenly disappear.

He noticed that at the time of the subsidence of the swelling there was an unusual flow of saliva in the mouth.

These attacks, as he called them, seemed to come with increasing frequency, and the discomfort became more and more distressing, so that he became alarmed and decided to consult a physician.

Upon examination around the angle of the jaw, both inside and outside, no area of tenderness or swelling could be found.

From the history, however, it was thought there might be some interference with the function of the salivary glands, hence the finger was passed inside of the mouth from the angle of the jaw across the floor of the mouth in the direction taken by Wharton's duct. Almost at once the finger was arrested by the presence of a hard, unyielding body. This was found to be located on the floor of the mouth, midway between the inner surface of the ramus of jaw and the frenum linguæ.

The mucous membrane around and over the foreign body was well cocainized and the body grasped between the forefinger and thumb, making the mucous membrane tense. An incision was made down to the foreign body, which was found to be a calculus. Some difficulty was encountered in separating it from its bed, but after a little manipulation this was successfully accomplished and the stone removed.

The wound in the mucous membrane and duct healed promptly and the patient made an uninterrupted recovery. All the unpleasant symptoms disappeared and the patient has since remained well.

1907 Chestnut St.

A RARE NASAL TUMOR. FIBROMA OF THE POSTERIOR END OF THE MIDDLE TURBINATE. REPORT OF CASE.

BY WILLIAM C. BRAISLIN, M.D., BROOKLYN, N. Y.

Jonathan Wright says, in his article on Neoplasms of the Upper Air Passages[1]: "While it occasionally occurs in and about the naso-pharynx, fibroma springing from the nasal structures is exceedingly rare." In 32,997 patients examined, only two fibromata of the nose appeared. Dr. Wright kindly examined the tumor here reported, and his comments on the case give me the reason for reporting the same.

Mrs. C. K., 35 years of age, was first seen September 12, 1905. She complained of a decided obstruction in her nose dating from the preceding winter—that is, for a period of something over six months. There was an uncomfortable feeling in the throat which she described as causing a great deal of mucus to collect there.

On examination, a large pinkish-white mass presented in the pharynx, projecting more or less from beneath the free border of the soft palate as the palatal muscles contracted or relaxed. On dilating the right side of the nose under cocain, the pedicle could be seen at the under surface of the middle turbinate, well posteriorly.

The tumor was grasped with a blunt-edged adenoid forceps, introduced through the mouth up behind the soft palate, and removed entire from the base of its pedicle. It was approximately 2 inch by 1 inch by ½ inch, or irregular shape, indented and moulded by the posterior nasal meatus and the pharyngeal space. Its outline was not unlike a hammer-head; one thick projecting portion had extended into the vault, the other and larger had hung pendant downward into the pharynx toward the base of the tongue. The pedicular portion, which had led into the posterior nares to its attachment, shows the impress of the middle turbinate.

Five weeks subsequently another small mass was removed from the same region, through the nose. This had every appearance of a mucous polyp, and was so pronounced by Dr. Wright.

Dr. Wright's opinion of the large tumor is that it is certainly a fibroma. There are a number of cellular elements in it; however, it is not so dense as the other one (Knight's case) examined by him and figured in his article referred to.

1 Am. Text-Book of Diseases of the Eye, Ear, Nose and Throat, p. 1080.

SOCIETY PROCEEDINGS.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Regular Meeting May 21, 1907.

J. HOLINGER, M. D., President.

PRESENTATION OF CASES.

Auastomosis of the Facial with the Hypoglossal Nerve. By JOSEPH C. BECK, M. D.

The case was one of angio-endothelioma of the middle ear, involving the facial nerve, in which a radical operation was done a year ago. A secondary operation was done on the facio-hypoglossal nerve, the anastomosis being made by implanting the facial into the hypoglossal seven weeks ago. Contraction is beginning to appear in the lower facial muscle. A recurrence of the tumor was also removed at the same time. Since then there has been no recurrence. The hypoglossal nerve was situated low down and considerable traction had to be exerted to effect the anastomosis; hence the nerve was kinked and this was the cause of this partial paralysis of the tongue. The patient was shown at this time, owing to the fact that this was the last meeting of the society this season, and the doctor wanted the members of the society to see this case at this time, so as to be able to compare the result next fall at another meeting. He will then exhibit the three cases operated successfully up to date.

DISCUSSION.

DR. JOHN G. WILSON: It is not possible to get the functional union of the facial nerve with the hypoglossal by merely laying the former along the side of the latter. What is necessary is to implant the peripheral end of the facial on to the central end of a part or the whole of the hypoglossal. To do this some fibres of the hypoglossal must be cut. So the paralysis Dr. Beck refers to as a flaw in his results, could not possibly be avoided; on the contrary he is to be congratulated that the resulting paralysis is so slight.

DR. BECK, closing the discussion: Dr. Wilson saw the first case I operated on and pronounced it a good result, and yet there was no paralysis. I did what I attempted to do in this case—implant the facial stump into the hypoglossal, turning it upward, so that the fibers from the hypoglossal would carry stimuli to the facial stump.

PRESENTATION OF PAPERS.

The Present State of our Knoweledge with Regard to the Physiology of the Sinuses Accessory to the Nose. By J. GORDON WILSON, M. A, M. B., (Edin.)

The various hypotheses that have been advanced from time to time to explain the presence of the accessory sinuses of the nose make an interesting chapter in the history of medicine. From the early period when they first attracted notice down to the present time more or less plausible theories have been in vogue. Thus, they have been supposed to serve to secrete mucus. But the position of the nasal openings of the principal sinuses is obviously opposed to such an hypothesis, to say nothing of the fact that under normal conditions mucus is not present in these sinuses. They have been held to be necessary to produce a sonorous voice. Especially was this supposed to be the case in regard to the frontal sinus; but the irregularities in its shape and the fact that it may be absent with no apparent alteration in vocal resonance, as well as its more or less obliteration in pathological cases with no apparent change of voice, require the abandonment of this theory. In the Orang, Zuckerkandl states that at one time he thought it possible that the large sinus maxillaris there present might act as a resonator; but the inconstancy of its formation led him to abandon this supposition.

Before discussing more recent views of the physiology of the accessory sinuses it may be well to recall certain facts with regard to their embryology and some points in regard to the physiology of the nasal cavity, which bear on this problem.

1. EMBRYOLOGY: The accessory sinuses are produced by the projection outwards of the nasal cavity. In the mesoderm which surrounds the primitive nasal cavity there is formed within its interorbital septum a cartilaginous plate with openings for the branches of the olfactory nerve. This plate sends down two cartilaginous laminae to form the side walls of the nose, and a medial plate dividing the nasal cavity into two parts. The ends of these cartilaginous side walls, and the ridges which appear on it, form the embryonic chief turbinates. Lying in these furrows between the ridges one notes accessory turbinates formed in the same way and separated by accessory furrows. In the course of development the embryonic chief turbinates are reduced in number to three or four.

The sinuses are developed by a widening out of the accessory furrows. This is especially well seen in the frontal sinus, which devel-

opes from a depression in the furrow which lies between the first and second embryonic turbinates. By the increase and growth of this into the frontal bone the frontal sinus is formed. At birth it is not present and only begins to appear as other than a slight depression about the sixth or seventh year. The sphenoidal sinus arises in the posterior part of the nasal cavity and by some has been regarded as the posterior part of the primitive nasal cavity enclosed in bone, by others as a depression which invades the body of the sphenoid. The maxillary sinus is foreshadowed by a small depression which is easily seen at birth on the side wall, in the furrow between the horizontal part of the first and second turbinates. The ethmoid cells arise from the anterior part of the chief embryonic furrows. In these the accessory turbinates and furrows widen irregularly, the tops of the furrows adhere more or less closely to form primitive chambers. The final state of the pneumatic chambers differs. Whilst the frontal, sphenoidal and maxillary press into the skull capsule, the ethmoidal are limited as a rule to the cartilage and bone from which they started, though occasionally they may invade the adjoining bones. It has to be noted that though the primitive ethmoidal cells have olfactory epithelium, the secondary never have. The frontal, sphenoidal and maxillary sinuses never have olfactory epithelium.

II. Comparative Anatomy: Comparative anatomy shows how widely distributed pneumatic chambers are, how large they may become, and what a variety of purposes they may serve. In birds, where they are well developed, their function has been the subject of much controversy. Generally the skeletons of large birds that fly well (Storke and Swans) are most pneumatic; but there are many exceptions. Thus the bones of the Swifts are solid and the air cells are chiefly confined to the cranium; many parts of the skeleton of the large Ratitae are very pneumatic. Some of the air sacs are for sexual adornment (Bustards); others act as resonators (Prairie Fowl); others serve as reservoirs for air(Lark and Nightingale). But their principal function seems to be to assist the respiratory mechanism by "ventilating the lungs and to regulate the exhalation of the watery vapor" (Newton).

In mammals in addition to those found in man, there may be others present. Thus in the deer they are present in the palate bone. They are very large in animals with massive heads, e. g., the elephant. The deduction one must make from a comparative study is that these cavities enlarge, with the least degree of weight, the osseous areas necessary to these animals. At the same time one

notes that animals with perfect smelling apparatus have very large ethmoidal cells, which outweigh the frontal and sphenoidal sinuses; and that animals with very little smell have the ethmoidal cells reduced in size or may even have them absent.

III. PHYSIOLOGY: There are four hypothesis in regard to the physiology of the accesory sinuses that I wish to discuss.

1. That they supply warmth and moisture to the inspired air.
2. That they are olfactory cavities.
3. That their position causes a passage of air over the olfactory mucous membrane.
4. That they lighten and increase the mobility of the head.

1. *That they supply warmth and moisture to the inspired air.*—All acknowledge the advantage of nasal respiration and recognize that the inspired air receives heat and moisture. We have very good proof that this is the function of the turbinates. We have no reason to believe that the accessory sinuses play any part in this, but on the contrary we have, I believe, very good proof that they have little or no effect on the change. In the first place, the mucous membrane of the sinuses is very thin and poorly supplied with glands and blood vessels. Again, the cavities themselves are relatively too small to have any perceptible effect even supposing they were capable of being sucked dry; I believe the amount of air that passes out during inspiration is relatively small. In short, it appears to me that the supply of warmth and moisture they are capable of giving as cavities is practically negligable.

2. *That they act as olfactory chambers.*—As opposed to this one finds that the olfactory nerve has no endings there; that the lower apes and children in whom smell is present have no sinuses; and that anosmatic animals possess sinuses. Against this not one positive fact can be advanced to support this hypothesis.

3. *That their position causes a passage of air over the olfactory mucous membrane.*—This theory is based principally on the experiments of Braun and Classen, who showed that there was considerable variation in pressure during respiration in the chambers accessory to the nose; and concluded that while in normal respiration the air does not pass over the olfactory region, yet the secondary current resulting from this variation would carry odorous particles to the olfactory mucous membrane. There are many objections to this hypothesis. Thus acknowledging that secondary currents exist, it was not shown how those related to the frontal and maxillary sinuses could affect the olfactory mucous membrane. Further, if the sinuses play so important a part in smell, it is difficult to

understand why in man they develop so late in life and may even fail on one side without compensatory enlargement on the other; also why in some of the apes they are poorly developed and sometimes not present.

4. *That they lighten and increase the mobility of the head.*—The study of comparative anatomy strongly favors the view that pneumatisation of bones is for the purpose of combining strength with lightness. This is well seen in the larger mammals. For instance, in the elephant, where the massive head with its relatively small cranial contents has to give powerful insertions to a musculature which will move the head and trunk, we find the air chambers of huge proportions. In the apes the small head with the small cranial contents and the reduced amount of musculature is associated with a diminution and in some cases an absence of sinuses. In man, the increased size of the brain to be protected and supported, is accompanied by increase in the size of the sinuses.

At present the weight of evidence appears to me to support this hypothesis. Yet there are some points which make one hesitate to assert dogmatically that this is their only function. Chief among these is the fact that developmentally they are the outgrowths of the nasal cavity—respiratory or olfactory. A complete solution can only be hoped for, from a study of embryology and comparative physiology.

DISCUSSION.

DR. E. FLETCHER INGALS: This Society is to be congratulated on having a member who is willing to devote his time to research in a subject about which we know so little, and need to know so much.

DR. CHARLES M. ROBERTSON: I do not quite understand the litmus paper experiment. It seems to me that if the doctor put litmus paper into the opening made in the frontal sinus, air would pass through there during inspiration.

DR. WILSON: The glass tube is put in air-tight, so that no air can get in.

DR. ROBERTSON: As regards the function of the accessory sinuses, aiding in the resonance of the voice, the only way to determine that would be by making a photograph of the sounds, which is done by the sound waves producing vibrations and recording them on an apparatus made for that purpose. I think that the presence of anything in the nose certainly does impair the resonance and it has always seemed to me that the accessory sinuses were particularly adapted to increasing the resonance in the voice.

So far as the olfactory function is concerned, I am sure that no olfactory nerve filaments are to be found in the membrane lining these cavities. As for warming the air that is inspired, one can see how that would be possible if the air came in contact with the mucous membrane, but if these accessory sinuses posses any function at all, it is probably that of regulating the resonance of the voice.

DR. EDWIN PYNCHON: It seems to me that one of the functions of the sinuses is to lighten the bone in such a way that the brain does not suffer by concussion in case of external injury.

As regards the influence of the sinuses upon vocal resonance, they undoubtedly contribute much to this purpose. Of all races, the Africans have sinuses as large as any, and the singing voice of the African is known to be very melodious.

As regards the function of warming and moistening the air, it appeals to me very strongly. In fact, I fully believe that this is the chief and principal function of the sinuses.

As regards the direction of the air current in inspiration and expiration, it is well known from investigation made by Freeman, of Philadelphia, and others, that the inspired air passes chiefly about the middle turbinal. In fact, as it strikes the middle turbinal it is divided so a portion thereof goes through the superior meatus. Why does the air go in this direction? The openings or anterior nares are almost horizontal and if air is drawn in slowly, it may not take that direction, whereas when it is drawn in quickly it will go toward the roof of the nose. Why is it that the air goes out through the lower part of the nose in expiration? The air in its outward passage strikes the vault of the nasal space, which tends to direct the current toward the inferior meatus.

DR. J. HOLLINGER: The function of the accessory sinuses of the nose in one animal cannot be compared with the functions in every other animal. Take, for example, the elephant, where the system of frontal sinuses is developed to such an extent that the whole front and upper part of the immense skull is a mass of sinuses. The object undoubtedly is to create a large crest over the back of the head for the insertion of the muscles of the neck, governing the motion of the trunk. The function of the sinuses is merely an architectural question because of the need of a large place of insertion for these muscles.

Another point is the great difference in size and relative position of the sinuses existing among the various races of men. I think we hardly made a fair test in the investigation of these problems

by taking accurate measurements of the width and height of the face compared with the width and height of the nose. This so far has produced no other result than to show that the width of the face is proportionate to the width of the nose. In other words, that the width of the maxillary sinuses are equally proportionate to the width of the face. There are such great differences in the architecture of the skulls of different races that I think we might by comparing those factors get at the points equally as well as by comparing the skulls of the different animals.

DR. WILLIAM L. BALLENGER: I want to ask Dr. Wilson a question. We are at times placed in a position where we must operate on these sinuses. From a physiologic point of view, what harm might result from a complete exenteration of the ethmoidal sinus?

I frequently have had patients where, after removing the ethmoidal cells, the sense of smell was instantly restored. Of course, that was because of closure of the olfactory fissure before operation, and the diffusion of odoriferous particles did not take place.

DR. WILSON, closing the discussion: I am very glad that my paper has elicited such free expression of opinion on this subject. Of course, my investigations have just started. On looking up the literature on physiology of the sinuses, it proved to be very small in amount. In discussing the subject one has to remember that it is not enough to frame an hypothesis which may appear satisfactory in one or two animals, or even in man. What we want is a theory that will be generally applicable to these accessory sinuses. The theory which best satisfies these conditions at present is the one which holds that these sinuses lighten the weight of the head and increase its mobility. To object to such a theory by statements based on belief in the efficacy of some other hypothesis is not enough. For instance, it is not enough to say that one believes that the lining membrane of these sinuses imparts warmth and moisture to the inspired air. One must give foundations for the belief.

As to the question of these being vestigial remains of olfactory organs, I do not know that that will help us out. Simply to mention such looks to me like begging the question. So far, not the slightest proof has been advanced in support of this contention.

Dr. Pynchon raises an important point when he draws attention to the question of the projection of the superciliary ridges as an index of the size of the frontal sinuses. That their size may bear some relation to the size of the sinus one must acknowledge, but to regard them as indices would be, it appears to me, to attach undue

importance to their prominence and inevitably lead to miscalculations. Anatomically one may find large ridges and by no means corresponding large sinuses; to give but one example, negroes have marked superciliary ridges, but as a rule small frontal sinuses. The other point Dr. Pynchon raises, that normally the main current of inspired air rises as high as the superior turbinal, I cannot agree with.. I should place it in relation to the middle turbinal.

I have left Dr. Robertson's remarks to the last, since I recognize here a difficulty in giving satisfactory proof. We have no evidence that these sinuses act as resonators. As cavities accessory to the nose they may secondarily do so by modifying the amount of air space in the upper passages so as to affect resonance. Their position, their variations in size, the character of their openings speak against their main function being resonating cavities; and in addition the true resonators are developed in relation to the sound producing organ—the larynx. I do not know that the voice has been photographed before and after sinus operations.

I have been asked what harm could come from removal of the ethmoidal sinus. Speaking generally, one would say that the primary harm would come from the destruction of the olfactory mucous membrane, necessitating injury to its lymphatics which connect so closely with the subarachnoid and subdural spaces. Further, the relation of the posterior ethmoidal cells with the optic nerve has to be thought of.

What Constitutes an Adequate Preparation for Practice in a Special Field. By GEO. E. SHAMBAUGH, M. D.

Work in the several special fields has been carried so far beyond the scope of the work that the internist is prepared to do that the necessity for special training for the men entering the practice of the specialties is apparent. The development of the specialties has come about so rapidly that this demand for special training is necessarily a recent one. It presents a problem in medical education we have not yet solved. A few weeks or months attendance on clinics in our so-called post graduate schools does not in any measure constitute an adequate preparation for the men entering the practice of a specialty. The training of the specialist should be as much in the fundamental sciences of his speciality as in the clinical side. In the training of the general practitioner we require a knowledge of general anatomy, general physiology, embryology and pathology. It is just as essential that the specialist in order to have a

clear understanding of the clinical problem of his specialty should have a thorough training in the special anatomy, the special physiology, embryology and pathology of the field with which he has to deal.

This work should be put on the basis of genuine graduate work; that is, it should lead up to the frontier line where the actual research is being done and where the unsolved problem in the subject can be presented and discussed. This work can be properly done only in our universities. It could be so arranged as to lead to the granting by the university of a higher degree in medicine, the degree of doctor of Philosophy, for example, in Ophthalmology, or in Otology, just as is now being done for the men working in the other sciences, as physics, chemistry, etc. The offering of such courses even by one or two of our best equipped universities would serve to stimulate higher ideals and better preparations in physicians all over the country entering upon the practice of the specialties. Our great need is not for more specialists, but for properly trained specialists.

DISCUSSION.

DR. NORVAL H. PIERCE: I have been teaching in post-graduate work for over fifteen years, and I very soon found how inadequate such work is. It is a shame that in this great city post-graduate work has gone to such absolute misuse. That it is foolish for a man to come here and study six weeks at the most and expect to master a specialty that requires at least considerable manipulative dexterity is apparent. I do not recall a single instance where I have regarded the work done by such men who came to my clinics as in any way satisfactory either to me or to those men for my trouble. It is largely a waste of time. There is neither beginning nor end. It is all chaos. I am sure that every man who has had any experience in this line of work will agree with me the time has come when such a paper as Dr. Shambaugh's is exceedingly timely.

How many of us are familiar with the science of sound? How many of us realize the difference between mass vibration and molecular vibration? How essential these problems are to the comprehension of our daily work? Therefore, I am in hearty sympathy with the proposition that physics as relating to sound should be a requisite in the training of the otologist, as much so as is the embryology and the anatomy of the parts. I wish to voice my appreciation to Dr. Shambaugh for this timely paper.

DR. J. G. WILSON: We are all agreed, Mr. President, that the improvement of the post-graduate instruction is one of the most urgent needs in present day medical education. This Society ought to do all in its power to further the object that Dr. Shambaugh has so well stated in his paper. I feel confident that if a representative body of medical men in Chicago should ask the universities in the state to assist in the advancement of post-graduate work, these universities would listen with a great deal of sympathy to the request. But the sincerity of the request must be evident in the hearty, unselfish cooperation of each society and of each school. To attain to this we require to educate not only the general practitioner, but the specialist, and I look upon Dr. Shambaugh's paper as a necessary step in that direction. So far as a special degree is concerned, I regard that of less importance. No doubt such a degree would give a hallmark to a man, indicating what he has done; but I believe its possession would be apt to be over-estimated. What is wanted at present is opportunity to work in the branches directly bearing on our specialties. Is it not possible to have all the schools in Chicago, interested in Laryngology and Otology, agree to organize and recommend to their graduate students special lectures on scientific subjects and special practical courses in anatomy, physiology and pathology, bearing directly on these special subjects, such lectures and courses to be given by competent men, who should receive sufficient remuneration? Such courses might very well fit in with, and form a valuable adjunct to, the clinical instruction which these schools are at present so well giving.

DR. C. M. ROBERTSON: It is a shame that men can come to this city and take up a specialty, stay six weeks or even less, and then feel that they have mastered it all. There is a movement on foot now in the University of Chicago, where Dr. Shambaugh and Dr. Pusey are doing work of this kind, and in the Northwestern University there is under advisement at the present time a course to elaborate such a scheme as this. The only question is, how much can you force the under-graduate student to do in this work, and also how can you teach post-graduate work in the under-graduate school?

As regards post-graduate teaching, men do not care to spend more than six weeks here, although the facilities for teaching are just as good as they are elsewhere. Many of these men go to Germany, even though they do not speak or understand German. It seems to me that the post-graduate schools of this city are at the

end of their string. That is shown by the fewer number of students coming here. They are not coming because they can get better work elsewhere, and yet our facilities are the equal of any. It seems to me that courses in pathology, physiology and anatomy are very essential. I tried to arrange such a course in the policlinic, but when I submitted it, all the men in the school jumped on me and said that I was trying to advance myself at the expense of others. So I dropped it.

Every member of this Society ought to bring his influence to bear on the colleges of this city, so that every man might take up a certain amount of work, if desired, and become proficient in it. If he inclines to laboratory work, let him become an expert in that work. So, too, with clinical and dead-house work. The universities all seem willing to do it, and some of the post-graduate schools do it. Those that are run for profit may not be willing to do this, but even if they are not, the students would go to schools where they can get the work they are after.

DR. JOSEPH C. BECK: The solution that appeals to me is one recommended by Dr. Price, of Philadelphia, a gynecologist of note. He believes that every specialist should take into his services a young graduate and teach him his specialty. I have followed this method ever since I have been practicing a specialty, keeping the young man with me for at least three years. The third man is still assisting me, and a second man has begun his course. I consider the first man a specialist. I believe Dr. Shambaugh's suggestions are excellent. Every man contemplating special work should take up anatomy, pathology and physiology as outlined by Dr. Shambaugh. I would suggest, with reference to pathology, that we are very negligent in not studying the tissues which we remove but throw away. Of course, we have not time to work them up, but I am sure that it would be possible to have the student whom one is developing as a specialist examine all tissues. That would do much for hysto-pathology.

In regard to the education of post-graduates, it has been my experience that these men are particularly interested in the removal of the tonsils and adenoids, and the use of the spray. Pathology and diagnosis is sadly neglected. If there are not enough schools to train specialists, there are plenty of specialists who can do this work.

DR. J. HOLINGER: There is one point which I think we overlooked, and that is the financial question. If a man has devoted himself up to his twenty-fifth year to the study of medicine, he cannot,

as a rule, afford to work two or three years without any remuneration, and at an increased expense to himself. The undergraduate student can live cheaply, but after graduation he cannot do this. He must have a good appearance and he must live in good quarters. Therefore, assistants in large clinics ought to be paid some salary. The attending men also ought to obtain some compensation that he can give a certain amount of time to this work of training competent assistants.

DR. SHAMBAUGH, closing the discussion: I am, of course, much pleased with the discussion my paper has received, and most of all because it has brought out the fact that we are more or less of the same opinion in regard to the need for more adequate instruction to the men entering the practice of our specialty. This field of graduate work is a comparatively new one, and the problem of giving proper training is still to be solved. I am a firm believer that in the solution of this problem, Chicago will play an important part. The discussion of this evening shows that the men in this Society have the first requisite necessary to bring about a proper solution of the question, i. e., we have an appreciation of the great need for such work. The men in this city who would participate in the development of proper graduate training for the prospective specialist must realize first of all that it will be expected of them to devote enough time and thought to some particular branch of our work, so as to command from others the recognition that they are an authority in this particular thing. One thing certain, the men of this country who are entering specialties and limit their preparation to a six weeks' post-graduate course or to a few months' trip abroad are not adequately prepared. The mere hanging out of a sign does not make a specialist of a general practitioner. We are coming very rapidly to the stage where to be recognized as a specialist the physician will be expected to have made a careful study of some branch of the specialty that he will be able to make a contribution to our knowledge of this field. It is not material that this contribution should have a special practical bearing as far as we are able to see at this time. A specialist who makes a contribution to the embryology or the histology of a part of the organ we have to deal with must of necessity have familiarized himself in a large measure with the whole anatomy of this region; otherwise he would be unable to prosecute successfully any piece of research, however technical.

BOOK REVIEWS.

Tracheo-Bronchscopy, Esophagoscopy and Gastroscopy.

By Dr. Chevalier Jackson, Pittsburg, Pa., Large octavo, 200 pages, 83 illustrations, 5 full-page colored plates, bound in cloth. Price, $4.00 *net* (Foreign, 17 sh., 17 mk., 21 fr.). Sold only by Subscription direct to the Publishers—The Laryngoscope Co., 3858 Westminster Pl., St. Louis, Mo., 1907.

The visit to this country last June of Prof. Killian, the discoverer of bronchoscopy, his brilliant operating, his painstaking demonstrations and his winning personality aroused great interest in the instrumental examination of the trachea and the bronchi and of the esophagus. At that time it was very gratifying to the American specialists that one of their number had something worthy of the cause to show Prof. Killian in return. Dr. Chevalier Jackson did this by his demonstration of the instrumental examination of the whole of the interior of the stomach and his exposition of its far-reaching possibilities for diagnosis and treatment. It is an added source of gratification that within the month Dr. Jackson has issued the first book on the subject of gastroscopy and its allied subjects, esophagoscopy and bronchoscopy.

Seldom has a medical book been more timely. Besides being the only book on the subject, it is a most excellent one. It is well printed, well illustrated, thoroughly indexed and contains a complete bibliography. The men who have done work along similar lines with the author will find their work credited to them in this book and given a good setting. As this class of work is based upon special instruments and upon special methods of instrumentation, the author has gone into all mechanical details carefully and minutely. Operating room arrangements have been described and illustrated in order that the operative procedures may be carried out in the most orderly manner. Only those who have attempted to do this kind of operating know how easily confusion and aimless manipulation may creep in.

The bronchoscope which bears Jackson's name is, as he states, the esophagoscope of Einhorn transferred to the trachea. Jackson modestly sets forth the advantages of the self illuminated tube and courteously gives due praise to the Killian tube which is lighted from the far end. I feel strongly that the self illuminated tube is much the better. The writer says very pertinently that if you are dealing with electricity you must take the trouble to learn something about it. Those who neglect to do this should not be astonished if their apparatus balks. Operators who are not willing to look after details of mechanism would do better to let bronchoscopy alone.

Even the specialist often considers bronchoscopy and esophagoscopy only as a means of dealing with foreign bodies in the trachea and the esophagus, forgetting the great role that these methods of examination should play in the diagnosis and treatment of chronic diseases of these tracts. For example, much of the modern surgery of the stomach centers about pathological conditions of the pylorus. By gastroscopy Jackson has shown that it is possible to examine the pylorus. Jackson's most valuable work, it seems to me, is the work which he has done upon the stomach and upon thymic asthma. His continued work upon these subjects should furnish results even more important than the brilliant ones which he has already obtained.

Where a book contains so much that is new it is almost impossible to review it adequately. One is tempted to quote extensively. I feel that it is better, however, to refer the reader directly to the book itself, assuring him that he will find it what he needs, and that he will get from it the inspiration which comes from studying a new subject the possibilities of which are just being recognized and developed.

Harris Peyton Mosher.

ERRA.

In May number, page 343, 22 lines from top, read "**lower** turbinate" instead of "**middle** turbinate."